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A STUDY OF THE MAMMALS OF CHAMPAIGN COUNTY, ILLINOIS.

BY

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ERRATA AND ADDENDA.

Page 58, line 7, for *ovalis* read *ovata*.

Page 85, line 8, for *longicaudus* read *longicauda*, and just above *Phacus pleuronectes* read the following paragraph:—

Phacus longicauda var. *torta*, n. var.—This variety, for which I propose the name *torta* because of the twisted body, is figured by Stein ('78, Taf. 20, Fig. 3). It occurred sparingly in midsummer from July to September, rarely in October, in 1896 and 1897.

Page 91, line 18, after *T. caudata* Ehrb. read *T. lagenella* Stein.

Pages 153, line 3 from bottom, 168, line 16, and 178, line 14, for '*98* read '*98a*.

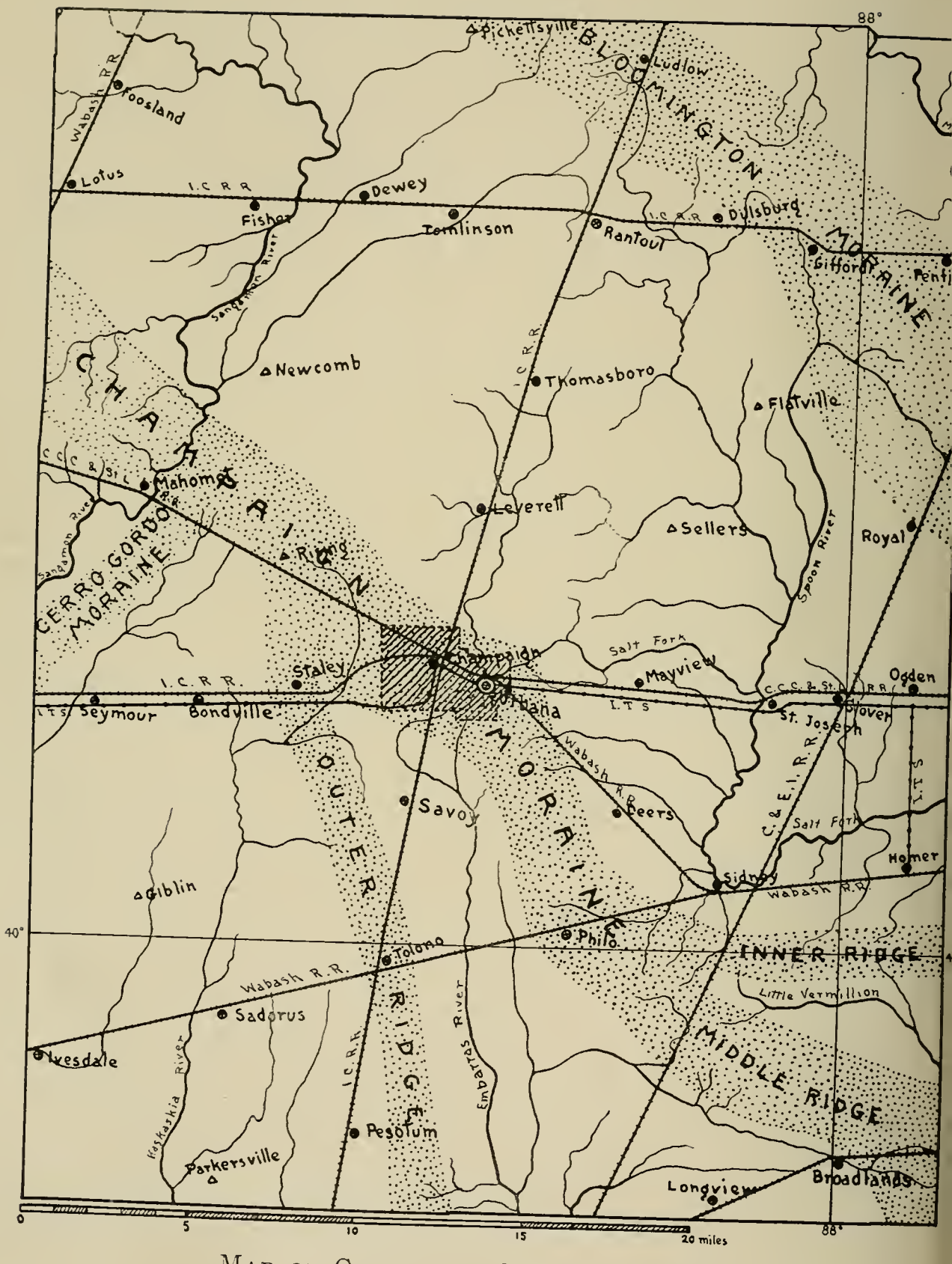
Pages 156, line 11, 159, line 16, and 161, line 5 from bottom, for '*93* read '*98a*.

Pages 175, line 5, 186, line 3, and 208, line 17, for *Bimærium* read *Dimærium*.

Page 288, line, 3 for *Lampsilus* read *Lampsilis*.

Page 292, line 13, for *gracilis* read *gracile*.

Page 471, line 3 under heading beetles, for *pennsylvanicus* read *pennsylvanica*



Map of Champaign County, Illinois.

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ARTICLE V.—*A Study of the Mammals of Champaign County, Illinois.* BY FRANK ELMER WOOD.

TOPOGRAPHY AND MAMMALIAN HABITATS AND ASSOCIATIONS.

Champaign county lies in the east-central part of the State of Illinois. It is rectangular in shape, extending thirty-six miles north and south and about twenty-eight miles east and west, its area being almost exactly 1000 square miles. Urbana, the county seat and the seat of the University of Illinois, is near the center of the county. The geographical location of the university observatory is 40° 6′ 20″ north latitude and 88° 13′ 28″ west longitude.

The general topography of the county is that characteristic of the prairie region of the Mississippi Valley. It is essentially a level or gently rolling plain very moderately diversified by moraine ridges and shallow river valleys. The highest elevation recorded for the county is 830 feet above sea-level and the lowest is 610—giving an extreme variation of 220 feet in the thousand square miles of territory.

The county lies entirely within the limits of the glacial deposits of the Wisconsin epoch. Two morainic systems of the Wisconsin drift cross the county. The outer crest of the Bloomington moraine crosses the northeast corner. The ridge is two to five miles broad, and rises to an average of about 50 feet above the plain to the southwest. While the ridge is well defined in places, for a large part within the county it is represented only by low knolls and winding ridges. Between these are broad shallow basins and sags that are often difficult to drain. The Champaign moraine crosses the county from northwest to southeast a little south of the center. At its entrance into the county on the western border the system consists of a single ridge, but near Champaign divides into three distinct ridges which continue, separately, in easterly, southeasterly, and southerly directions across the county.

The depth of the glacial deposit southwest of the Champaign moraine is 100 feet or less. North of this it is considerably more, and Leverett estimates the average depth for the county as about

200 feet. There are no natural outcrops of the underlying rock within the county limits.

A glance at a map representing the rivers of the state will show that a number of important rivers rise either within the county or immediately north of it and flow in all directions but a northerly one. The Sangamon crosses the northwest corner of the county, and with several prairie streams or tributaries drains that quarter of the county. The Middle Fork of the Big Vermilion (of the Wabash) just enters the northeast corner, and the various branches of the Salt Fork of the same river drain the most of the eastern half of the county. The southwest quarter is drained by the head waters of the Kaskaskia and Embarras rivers. These last two streams are in this section little more than prairie creeks with steep earth banks and undeveloped treeless valleys. The Sangamon and the larger tributaries of the Big Vermilion have the same general characteristics. In the vicinity of the moraines they lie in narrow, well-defined valleys, which usually rise in steep bluffs on one side, 30 to 70 feet or more in height. The flood-plain, usually narrow, may reach a quarter of a mile in width. Beyond the moraines, in the till, the valleys are lower and not so well defined. All these streams are subject to heavy floods. In summer, however, their muddy waters flow between steep earth banks 4 to 8 feet below the flood-plain.

Originally a belt of timber, sometimes narrow, but sometimes attaining a width of nearly two miles, extended along these larger streams. It was almost invariably broader on the east and north sides of a stream than on the west and south sides, a possible explanation being that woods on the south and west would be more exposed to prairie fires driven by the prevailing southwest winds. It is needless to say that this primitive condition has been greatly modified since the settlement of the country. The steep bluffs along the rivers are in general still covered with timber, though it is usually of small size and recent growth, and dense thickets and woods with heavy undergrowth still occur along the river valleys and on the flood-plains; but, for the most part, the broad belt of forest that formerly encroached on the prairies along the streams is represented only by scattered groves of second growth, and these are usually much thinned out, and the underbrush is kept down by grazing. These river-belt areas still furnish the chief cover and highway for the migration of many of the larger mammals left within our area.

In these areas there is still considerable pasture or fallow land. There is even an occasional remnant of a rail fence, while thickets in the fence corners, brush along the fences, and other forms of agricultural untidiness are a protection to wild animal life in general.

Outside these river valleys there were a few scattered groves, from 20 to 160 acres in extent, which served as landmarks and were known by special names for many miles around. With the exception of the moraines and the narrow belts along the larger streams the country was naturally a very gently rolling prairie. It bore, too, the character of a country of recent geological age where drainage was still undeveloped. The windrows of glacial drift were very imperfectly cut through, and shut in the surface water in shallow basins. The encroaching vegetation and vegetable deposits had changed these basins to what were shallow sloughs or marshy lakes in a rainy season, but became soggy meadows in time of drought. Though the main streams had cut deep into the till, the smaller headwaters had eroded but little. Indeed, along their upper courses their erosive action must have been zero, and they represented little more than the course along which the drainage waters seeped their way, through dense vegetation and matted debris, to a lower level.

For detailed study of the distribution of its mammals, the county may be divided into

Till plains,	Groves,
Moraine ridges,	Permanent pastures,
Wooded bluffs and ravines,	Flood-plains.

TILL PLAINS.

(Plate XXVI., Fig. 1.)

Under this designation are included the extensive, nearly level prairie areas lying between the higher, more uneven moraine belts. These plains are the most characteristic and the most extensive feature of the topography of the county. They vary little in level, often less than five feet within a square mile. Portions were originally wet and swampy, but all are now drained and under thorough cultivation. Some of these areas, however, although extensively underdrained and capable of thorough cultivation in ordinary years, are nevertheless sometimes covered by a few inches of water during the early spring, and such areas—usually of small extent—

are as destitute of permanent mammalian life as though they were perpetual swamps.

The land is exceedingly fertile, and every square rod that can not be kept under constant cultivation is a chronic annoyance to its owner. The fields are large—except in the vicinity of towns—running from 40 to 160 acres, or even more. Cultivation is thorough, and but few waste places along fences, ditches, etc., are permitted. There are but few hedges, orchards and groves are small and uncommon, and but little land is left in permanent pasturage. Narrow strips, barely two feet wide, along the wire fences, and belts a dozen feet in width each side of the roads—which are regularly laid out a mile apart—with limited spaces around the dwellings, are about all the land not turned up by the plough three years out of four.

Apparently nothing but a veritable desert could be more unfavorable for mammalian life than these large well-tilled fields. They contain, however, considerable numbers of mammals at all times, and, really, an abundance of them at certain seasons. A common permanent resident of such fields—always present unless driven out by standing water—is the white-footed prairie-mouse, *Peromyscus maniculatus bairdii*. An illustration, based on repeated experiments, may throw some light on the abundance of this species. In large corn fields of 80 to 160 acres, when the corn was about one foot in height and was being repeatedly harrowed and kept almost absolutely free from weeds, I repeatedly set traps near the center of the field, at every tenth hill along the rows, with no regard to any indication of the presence of mice. The average result from one night's setting was a white-footed mouse in about one trap in ten. Very rarely a specimen of the short-tailed shrew (*Blarina brevicauda*) was taken. If these traps were set near the edge of the field, the proportion of traps containing animals was increased; and if near an old hedge, waste land, or roadside, specimens of the prairie-vole (*Microtus austerus*) might be taken, and the average of successful traps would rise to one in five for a single night. The same average would hold for traps set at the same distance apart in stubble or corn fields from which the crop had been cut and removed. My averages of successful traps set in the same way across a corn field, where the corn had been husked without cutting, was also about one in five.

When one considers how small a proportion of the animals present would be likely to find traps thus set across a field, one is forced to conclude that the number actually present at all times may be considerable, even in the middle of the best-cultivated fields. If traps are set along fences between such fields, at every post, the number containing animals will rise to one third or even one half of the traps. The average number of birds found in the corn fields of this belt was nearly one to the acre, and the number of mammals present, even in the middle of the larger fields, can hardly be less, while for the whole belt it must be considerably greater. During spring and early summer, as we have said, white-footed mice constitute the great bulk of the mammalian life in the center of these large fields. Near the edge the mole, *Scalopus aquaticus*, may be present, sometimes in considerable numbers, but it seldoms penetrates more than 50 yards into the field. Shrews, voles, and gophers are present along the fences and in adjoining fields not too recently disturbed, and make short incursions into the corn fields at that time of year. But in fall, if the grain or corn be shocked and allowed to stand a fortnight or so, traps set by the shocks show quite different conditions. The following may serve as a rather extreme illustration. In a corn field on the university farm where the white-footed mouse had been taken early in the year (1907), after the corn had been cut and shocked for some time fifty traps were set over night, one by each of as many consecutive shocks. The next morning thirty-seven of these traps contained specimens—one of them a single house-mouse, *Mus musculus*. In 1908, thirty-one traps were set in the same field under similar conditions except that the corn had not been shocked so long, and only ten specimens were taken, nine of which were house-mice and one was a white-foot. At first the conclusion was drawn that the house-mice had entirely driven out the prairie-mice. However, when traps were set in an adjoining part of the same field from which the shocks had been removed, the usual number of white-footed mice was taken, with the addition of one specimen of the house-mouse. Evidently the house-mice invaded the field after the corn was cut, and the prairie-mice were either driven from the shelter of the shocks or disdained it. Probably the former is the truth, for I have often taken them by recently cut shocks of corn and grain.

Wherever there is a bit of waste ground where grass and weeds can grow undisturbed the prairie-vole and, more rarely, the Pennsylvania meadow-mouse (*Microtus pennsylvanicus*) are present, and together with the short-tailed shrew will invade the fields soon after cultivation ceases. These and the house-mouse are always taken in fall, unless the ground is quite cleared of standing or shocked corn or grain. In clover fields, meadow-lands, pastures, and alfalfa fields, especially when these crops have grown on the same land for several successive years, the prairie-vole becomes the dominant form, with the mole a close second, especially around the margin.

Wherever there are piles of rubbish, old ricks, compost heaps, etc., these serve as homes of house-mice, and, if large, of rats, *Mus norvegicus*. From these centers the former spread out into the adjoining territory. Along the small streams—mere drainage ditches usually—so long as they contain a trace of water, muskrats are really abundant. These ditches serve, too, as highways for minks and weasels. The former especially take refuge in the open mouths of the tile drains. When the ditches are a little larger and their banks are bordered by a rank growth of grass and weeds, this furnishes shelter for rabbits the whole year through. Rabbits are abundant, too, during fall and early winter, finding a precarious shelter under clods and fallen stalks during the light winter snows of this part of the state.

Where the till plains are devoted to pasture, or where they border the moraines, the striped gopher, *Citellus tridecemlineatus*, and the gray gopher, *C. franklinii*, are present, and enter corn and grain fields during summer and fall. The latter, so far as my own observations go, seems to spread out farther into fields of alfalfa and clover, while the striped gopher often takes up its residence in corn fields immediately after planting—to the exasperation of the farmer. Under usual conditions, the white-footed wood-mouse, *Peromyscus leucopus*, is not found in this type of locality. If, however, there be present anywhere a small grove, a neglected thicket, or an old hedge, one is almost sure to find this mouse. It is surprising how little of such shelter suffices for it, and yet it is almost never found without any shelter at all.

Skunks are occasionally seen in the fields in these plains, but they are not common.

MORAINE RIDGES.

(Map.)

To one accustomed to a hilly or mountainous country only, these elevations would seem too insignificant for consideration either as features of the topography or as factors in the distribution of animal life. They seldom stand more than eighty feet above the plains, and their rise is usually distributed over a mile in extent. But to those long accustomed to a prairie region they are striking objects, and even have something of quiet grandeur. Except in the vicinity of rivers, these moraines were destitute of trees, and were classed, with the till plains, as prairie by early settlers. The species of plants and animals found on these ridges are largely the same as those found on the plains, and the difference between the fauna and flora of the two is due chiefly to the relative abundance of the species in the two regions. The peculiarities of the moraines are due to better drainage, to the results of erosion, and to the greater exposure to the wind. In consequence of the better drainage aquatic forms are absent except in sags or in depressions. Because of erosion and leaching the black soil on the ridges is less deep and perhaps less fertile than that of the plains, and, consequently, under original conditions the vegetation was less luxuriant on the moraines. The exposure to wind, which perhaps so far as mammals are concerned is a negligible factor during the summer, becomes a very important one during the winter.

The conditions of cultivation on the ridges are practically the same as those on the plains.

These ridges are the favorite habitat of the striped gopher. Wherever the surface of the ground has been undisturbed long enough for these gophers to dare to dig their burrows one will be sure to hear their plaintive, questioning whistle on any bright summer day. Moles also are more abundant on the slopes of the moraines than anywhere else in the county. Under certain conditions the white-footed prairie-mouse is also abundant. These three species are often found together, and certain spots containing a few acres inhabited by them have the densest mammalian life that I have seen in the county. Their burrows are so close together and all three animals are so abundant, that I believe they do not interfere with each other in any way.

The gray gopher also is not uncommon along the edge of the moraines, but is apparently more apt to wander into the lower land than the striped gopher is. House-mice and rats are as abundant here as anywhere if the proper shelter is present. The prairie-vole is sometimes abundant, especially in meadows that have been for some years in grass or clover.

The sags in the moraines are usually occupied by a drainage ditch or natural watercourse, with a narrow border of waste land covered with rank vegetation. These belts are hiding-places for rabbits and hunting-grounds for weasels. Muskrats and minks follow the watercourses to their very sources.

WOODED BLUFFS.

As we have said, the principal streams were originally bordered on each side by a strip of timber of varying width. Under wooded bluffs we include such portions of this timber as are in the immediate vicinity of the streams or are practically continuous with woodland that is so situated. Where the original belt of timber was broad, certain portions have been isolated in the process of deforestation, and these isolated areas are much modified as regards both fauna and flora, and have been classed as groves.

In the early days the woods formed an almost unbroken highway for large animals from the extensive forests of the south and east. Along them, bears, wildcats, timber-wolves, and possibly pumas, entered the county. Later the last deer found refuge there. Although these wooded belts have been greatly narrowed and much thinned, they are still practically continuous for many miles, and so furnish a large range of woodland, and are the chief retreat of nearly all the larger mammals still found in the county. Wolves have been found along the Sangamon River up to a recent date, and probably a few still exist there. Whatever foxes, red or gray, may yet be in the county must den in these woods. They are the chief habitat of coons and opossums, although the latter have of late years taken to wandering long distances into the prairie. Skunks also are abundant in such localities, hunting extensively over the adjoining fields, but retreating to the bluff regions to dig their burrows. Kennicott stated in 1856, that the gray squirrel was restricted to the dense woods along the rivers. If there are any within the county limits, still in a state of nature, they are to be looked for

in such localities. Fox-squirrels are in general most abundant in these sections—probably because of better protection rather than from choice. Where they have the protection of groves they soon become quite numerous. The chipmunk is also practically limited to this region and its immediate vicinity. Bats are most abundant here, and the only records I have of flying squirrels within the county were also from this situation.

In summer the white-footed wood-mouse may be found in the margins of the woods or under shelter in the fields immediately adjoining, although nearly a hundred traps set in the middle of dense woods at that season failed to catch a single specimen. Late in fall and in winter, however, they were abundant in such localities. In fact, the middle of the larger, denser woods is surprisingly destitute of all animal life during the summer. Late in autumn the animals have returned, or at least appear again. The larger mammals are probably no more rare then than ever, but the smaller species seem to be lacking. At any rate, my trapping, persisted in for some time, was a complete failure then, though yielding an abundance of specimens in early winter. This fact supports the belief of most careful observers that wood-mice, voles, and shrews make a yearly migration to the cultivated fields in the spring, returning to the shelter of the woods in winter. I am inclined to believe that it is quite late in the year before all are back in winter quarters.

GROVES.

By groves we mean the small patches of woodland surrounded by treeless territory and not immediately connected by woodland with the woods of the river bluffs. In a few cases they have been planted, and a few are the remains of groves that were standing isolated in the prairie when the country was settled. It is possible that a few are self-sown extensions of the original woods and have grown up since white men came; but by far the most of them are portions of the old wooded tracts along the streams, and so are connected in origin with the woods of the bluffs. But whatever the origin, so far as the mammalian fauna is concerned the conditions are similar in all. The species of trees composing them are the same as those given for the bluffs, with walnut, the hickories, and occasionally green ash also, conspicuous. In general the trees are of medium size, and the woods are open. These wood-lots are usually closely

pastured, and underbrush is lacking, clusters of pokeberry and clumps of hawthorn being about the only thicket growth to be seen. To a certain degree the fauna, too, is distinguished from that of the wooded bluffs by what it lacks rather than by what it comprises. Foxes and coons, with the larger mammals, are lacking, and the opossum is generally only a visitor in these groves. The gray squirrel is not found in them except in a semi-domesticated state in towns, and the chipmunk is seen in them only in the vicinity of the wooded bluffs. On the other hand, some wood-mice, shrews, voles, and perhaps house-mice may be found at any season, and are abundant there in winter. The fox-squirrels soon take possession of groves in considerable numbers if they are not disturbed, but more often they have been exterminated in such places. The open portions of the wood-lots are usually undermined by a close mesh of mole-runs, and cultivated fields near by are sure to be infested by these animals.

Bats are not uncommon, and find roosting places in the hollow trees, and skunks and woodchucks may dig their dens under old stumps or other shelter.

These groves, in winter especially, are a favorite hiding-place for rabbits. After the first snow falls in early winter the hunters are sure to find them under nearly every brush-heap, fallen tree, or similar hiding-place.

PERMANENT PASTURES.

(Plate XXVI., Fig. 2.)

As we have seen, but little of the original prairie is used permanently for grazing, and the permanent pastures of the county are for the most part portions of the country from which the timber has been removed. In general, stumps, old half-decayed logs, thickets, and scattered trees remain as relics of the original condition of the land. The pasturing is usually rather close, but the waste growth of weeds and coarse grasses in swampy places and around thickets furnishes shelter for birds, reptiles, and small mammals.

These pastures are the favorite resort of the white-footed wood-mouse, and it is as characteristic of them as the prairie white-foot is of the corn fields of the prairie. Every large old stump, decayed log, brush-heap, or similar shelter is pretty sure to be the home of one. Next in real abundance, though even more conspicuous, are the striped gopher and the mole. Both of these, however, prefer the

richer fallow lands of the prairie, and in spite of persecution are more abundant there. Voles are sometimes abundant where the dense shelter of grass they require is present, and shrews are often taken.

In the northern part of the county, where woodchucks are found, their burrows are most common in the pasture-lands. Probably this would not be the case, however, if the farmers on the moraines were accustomed to keep their fields in clover for several successive seasons.

The other mammals found in the pasture-lands are transient visitors rather than permanent residents. The pastures are favorite hunting-grounds of the skunk, and it occasionally digs its burrow in the edge of a lot. In the vicinity of woodland, rail fences, or other continuous shelter, chipmunks may occasionally venture into the fields, and rabbits visit them and, rarely, make their nests in a thicket there.

The fact that these permanent pastures are in general much poorer in smaller mammalian life than the moraines of the prairie is not evident at first, but careful examination will make it apparent. The reason is plain. On the moraine belts there is abundant food and a comparative scarcity of larger *Carnivora* and birds of prey. The permanent pastures furnish less food, and are for the most part in the vicinity of woodlands that are the habitat of skunks, weasels, coons, and foxes, and afford nesting places for hawks and owls. It is another illustration of how little the direct persecution of man affects these smaller animals compared with the injury inflicted on them by their natural enemies.

FLOOD-PLAINS.

The portions of the river valleys subject to overflow for a longer or shorter period each year, though forming but a small part of the county, furnish a habitat of peculiar interest. For the most part these flooded tracts are from four to six feet above the summer level of the water, though unusual floods may rise much higher than that. For example, the high-water mark reached by the Sangamon in the spring of 1908, was fourteen feet above the water-level in September. These bottoms are usually sparingly wooded. The streams are often fringed with willows, the lower bottoms are treeless or bear a scattered growth of sycamore, elm, ash, and button-bush, while along the edge of the flood-plain, oak, water-maple, honey-locust,

and hawthorn may be found. Unless the timber is heavy and connected with a tract of wooded bluff it seems to make little or no difference in the mammals found. Among those found at present in the county, only the muskrat and the mink can be truly at home in these flood-plains at all times; but a number of small animals are abundant in these localities during the summer. White-footed wood-mice and short-tailed shrews (*Blarina brevicauda*) are found wherever the ground is dry and shelter, in the form of driftwood, stumps, etc., is present. Prairie-voles are common down to the zone of the sedges, but seldom in that zone or below it. Weasels hunt over the bottoms, and rabbits hide there. The more heavily timbered portions are a favorite resort of coons.

As the river-bottoms were in general the last portions of the country from which, at a certain stage in the development of this part of the country, the original heavy timber was removed, they furnished a last retreat for deer and other large game.

What becomes of the smaller mammals when these plains are under water? During the spring floods I have found voles clinging to the stumps that rose above the water. When approached they plunged into the water and swam off, or escaped by diving. I am told that in high water on the Illinois River, many white-footed wood-mice are seen on the trees above the water. Probably the mice and shrews both escape in a similar way in this locality during floods. The runways of moles are common along the edge of the flood-plain, but almost never occur at any great distance below high-water mark. In fact, their presence serves as a reliable guide to the limit of ordinary high water.

In spite of the fact that these small mammals swim so easily, the time of flood must be one of great mortality among them. The flood-plains are often forty rods or more across, and these animals are not strong enough swimmers to breast a moderate current, nor is it likely that they can live in the water a long time. Moreover, the time of high water is quite often the breeding season of these animals, and the very young must all perish. In the case of the comparatively small bottom-lands in this county it might be supposed that the mammalian population was kept up by immigration each summer from the surrounding higher ground, but that can hardly be true for the extensive tracts submerged each year along the Illinois and other large rivers.

DISCUSSION OF SPECIES.

POUCHED ANIMALS.

MARSUPIALIA.

OPOSSUM.

Didelphys virginiana Kerr.

(Animal Kingdom, 1792, p. 193.)

Under natural conditions the opossum was an animal of the woods and not of the prairie section, being especially abundant in the belts of heavy timber along the rivers; but as with advancing civilization these woods have been thinned out, and, on the other hand, as more shelter is furnished by groves, orchards, hedges, etc., it is possible that, though fewer in number, opossums have become more generally spread over the country than under original conditions. Although it can hardly be said of them in our vicinity that they are "equally at home in the lumber piles and hen-roosts of the town or among the untrodden haunts of the wilderness," they are nevertheless occasional visitors to farmyards and hen-roosts in the vicinity of our towns.

In their diet they are well nigh omnivorous, showing a decided preference, however, for eggs, young birds, and certain wild fruits, as persimmons and papaws. They also eat nuts, insects, and small animals, and, when pressed by hunger, they may feed on carrion.

The range of the opossum is throughout the eastern half of the United States north to the Great Lakes. It has been taken in New York at Schoharie, in Cayuga county, and near Rochester; near Erie in Pennsylvania, Ann Arbor in Michigan, and in the southern tier of counties in Wisconsin. It is common in eastern Kansas, and has been taken in Texas at Mason, San Antonio, and near Matagorda Bay. It is also found on Long Island, and has been introduced in Massachusetts and Rhode Island. Its range to the northeast has apparently increased during recent times, it having entered New York from the south and spread to the limits mentioned above.

The species shows a tendency to become smaller and darker toward the south, becoming the subspecies *pigra* of Bangs, which is found in Georgia, Florida, and the Gulf states.

Gestation in the opossum lasts about seventeen days. From six to as many as sixteen, or more, may be produced in a litter, and available evidence goes to show that there may be three litters during the year—all between January and the last of June. The female is often found accompanied by the young of more than one litter. At parturition the female lies on one side, curling up so as to bring the vulva near the opening of the marsupial sac. The young as brought forth are pushed into the sac and attach themselves to the teats, remaining continuously attached for four weeks, and for much of the time during the three weeks following. They are only a quarter of an inch long and weigh but four grains at birth. They are hairless, and their eyes and ears are closed. The mouth is a minute opening just able to receive the slender teats of the mother. Growth is very rapid. The young leave the pouch when about two months old, weighing then 400 to 450 grains. Even at the first, however, they exercise all the functions of other young animals, breathing, eating, digesting, defecating, etc., and are by no means the unformed egg or embryonic mass they were once supposed to be. The tail is prehensile, and the very young are able to support themselves by one twentieth of its length.

In general the adults live separately, but pair a short time during the rutting season. At this time the males are exceedingly pugnacious and jealous of each other. They hide in hollow trees, logs, etc., but are said to be of a wandering habit, not remaining long in one locality.

Owing to peculiarities of anatomical structure, the movements of the opossum, if not graceful, are at least unusually free and varied. The thumb and hallux are both opposable, and Coues asserts that the opossum is functionally as truly four-handed as are most of the monkeys. The movements of the feet as a whole are nearly as free as those of the human hand. The body is easily curled into a ball, and lateral movements are unusually free. The tail itself serves as a fifth hand, and possesses so much flexibility and strength that the animal can easily support itself by a small portion of the tip. It is capable not only of flexion in a single plane, but also of a twisting motion by which it can be wrapped in a spiral

around a slender support, even when that support is nearly parallel with the axis of the tail itself. When not in use it is carried bent under at the tip in the shape of an interrogation-point. The agility and serpent-like flexibility of the opossum is illustrated by the process of regaining a support to which it is attached by its tail. It is thus described by Coues: "It bends the neck and shoulders strongly forward, reaches upward with its fore paws until it can catch hold of the loosely hanging hind feet; further action of all four extremities carries the paws to the root of the tail, which is firmly grasped, when the animal climbs up its tail 'hand over hand' until the point of support is laid hold of, after which by a peculiar squirming motion of the whole body the desired altitude is attained."

The opossum's habit of feigning death when attacked is well known, and "playing possum" has become a proverbial expression. Though this peculiarity has been often studied, there seems to be as yet no uniformity of belief among scientists as to how far the act is a conscious and deliberate one and how far an involuntary cataleptic or hypnotic trance due to fear. Certain it is that however advantageous the peculiarity may sometimes be, at other times it is as surely a disadvantage.

In captivity the opossum is an uninteresting pet, sleeping during the day and feeding mostly at night. When disturbed it shows its resentment by a hiss and a lazy, grin-like baring of the teeth.

HOOFED ANIMALS.

UNGULATA.

AMERICAN ELK.

Cervus canadensis (Erxleben).

Cervus elaphus canadensis Erxl., Syst. Regn. Anim., I., 1777, p. 305.
Elaphus canadensis Ray, Kennicott, in Trans. Ill. State Agr. Soc., I., 1853–54, p. 580.

Kennicott says that several elks were shot in Cook county and that an elk was killed near Mt. Carmel in 1830. I have not been able to obtain any proof that one was ever seen by the settlers in this county. Elks have been long extinct throughout the state.

VIRGINIAN WHITE-TAILED DEER.

Odocoileus americanus (Erxleben).

Cervus dama americanus Erxl., Syst. Regn. Anim., I., 1777, p. 312.
Odocoileus speleus Raf., Atlantic Journ., I., 1832, No. 3, p. 109.

This is the common deer of the eastern United States, and was originally found almost everywhere from New York to Florida and west to the Missouri River. It is still found throughout this range wherever not exterminated, and in any of the wilder portions, if protected, soon becomes common. The first settlers found deer very abundant in this part of the country. As the wolves were killed or driven off, the deer became more plentiful, reaching their greatest abundance between 1845 and 1855. They were common in the parts of the county bordering the larger rivers till 1865, and it seems certain that they still bred within the county limits several years after that date. One was seen near Homer as late as 1880. They are still seen occasionally in the southern part of the state near the Mississippi River. The hunters there believe that they cross the river from Missouri. I have no evidence that they still breed within this state.

BISON; AMERICAN BUFFALO.

Bison bison (Linnæus).

Bos bison Linn., Syst. Nat., I., 1758, p. 72.

The earliest explorers of Illinois all speak of the great herds of buffalo seen. It seems impossible to fix with any degree of accuracy the date of their disappearance from this locality, but it seems probable that it was before 1815. Certainly they were gone before the first settlers came. There were several deeply worn trails crossing the county in various directions, and these were used as roads by the early settlers. Mud-holes in which they had wallowed —called buffalo-wallows by the frontiersmen—were also common, and easily recognized till the land was cultivated. In Vermilion county—adjoining Champaign county on the east—there was a salt-lick toward which several buffalo-trails converged.

GNAWING ANIMALS.

RODENTIA.

FOX-SQUIRREL.

Sciurus niger rufiventer (Geoffroy).

Sciurus rufiventer Geoff., Cat. Mamm. Mus. d'Hist. Nat. Paris, 1803, p. 176.
Sciurus ludovicianus Custis, Barton's Med. and Phys. Journ., II., Pt. II., 1806, p. 47.

This species is found throughout the state where conditions are favorable. It is the commonest squirrel in the county, being apparently the only one now in a real state of nature. Its habitat includes all natural woodland where it is not persecuted, and it may be found in artificial groves and park areas if these are not occupied by the gray squirrel. It is said to prefer the open woods and edges of dense forests, while the deeper woods, the recesses of the swamps, and the heavily timbered river-bottoms are occupied by the gray squirrel. Beyond the state the fox-squirrel ranges from northern Louisiana to southern Wisconsin, and over the greater part of the Mississippi Valley, while the whole group included by Osgood under the specific name *niger*, is found from northern Florida to southern New York, its range on the south and west extending to central Texas and northeastern Mexico.

The length of such specimens from this state as are available indicates an average length of about 21 inches (530 mm.) with a tail of about 9.5 inches (240 mm.). This is somewhat less than the measurements usually given for the species. The series examined is too small, however, to determine local variations.

The dentition of the species is one incisor, one premolar, and three molars on each side above and below. This will serve to distinguish this species from *carolinensis*, in which there are two premolars on each side above in the adult.

But little has been added to our knowledge of the natural history of our squirrels since the observations of Kennicott, and the most that we can say is derived from his account.

They are inclined to be solitary in their habits, more than two adults being seldom found living together, and a pair remaining together only during winter and spring. The young are from two to four in number. Kennicott says that probably two litters are born each year, but it is difficult to reconcile this statement with

others he makes. Probably a single litter in March or April is all that is produced. The young are "ugly unsymmetrical little things at first, with monstrous heads and closed eyes; and it is some time before they acquire the elegant proportions and agile movements of their parents."

Squirrels are very fond of corn, especially when it is green or newly ripened. In corn fields near extensive woodlands one often finds traces of their work. The ears of corn are either partly eaten on the stalk or carried to a neighboring fence or log and eaten. In early days, when their numbers were much greater than at present, squirrels became a veritable pest at times; but now their numbers are so reduced that there is little to fear from them. Both this species and the gray squirrel are great destroyers of birds' nests, and thus indirectly do considerable harm. Woodpeckers and other birds nesting in hollow trees seem especially liable to suffer from them.

The fox-squirrel is used for food, and probably the most of this species and the gray squirrel which are killed are so utilized. In early times they were sold in large quantities in the city markets of the state, and after the disappearance of the deer furnished an important part of the fresh meat eaten by the settlers, being perhaps even better appreciated than they are now.

The winter nests and permanent homes of the fox-squirrel are in hollow trees, and the same nest is said to be occupied by a pair for several successive seasons. Temporary nests are built of leaves and twigs in trees. These are apparently used for only a short time, and although usually at considerable height, I have seen them at an elevation of not more than twenty feet. Food for winter is stored up in large quantities in one place, but nuts, acorns, etc., are buried singly and dug up as needed. Apparently they do not truly hibernate, but are active all winter.

Squirrels are protected by the game laws of the state from November 15 to June 1, but undoubtedly many are killed during the closed season. It is especially to be regretted that they should be shot in the spring during the breeding season, when the helpless young must perish also. Within the county limits it is doubtful if there is any enemy to compare with man in their destruction, though a few are killed by the larger hawks and owls.

I fail to find any record of extensive migrations of this species such as have been so often observed in the case of the gray squirrel.

There must be, however, considerable movements of individuals and couples from place to place. Any place suitable for them they are sure to occupy in a short time if they are not molested.

The fox-squirrel is said not to make so engaging a pet as the gray squirrel, nor does it take so readily to living in the immediate vicinity of man.

GRAY SQUIRREL.

Sciurus carolinensis Gmelin.

(Syst. Nat., I., 1788, p. 148.)

NORTHERN GRAY SQUIRREL.

Sciurus carolinensis leucotis (Gapper).

Sciurus leucotis Gapper, Zool. Journ., V., 1830, p. 206.

The gray and the northern gray squirrels are probably both present in the state. They are closely related and have often been confused. Probably intermediate forms occur in this part of the country.

Both these gray squirrels are smaller than the fox-squirrel, have less of the rufous color, and are also distinguished from it by the dentition. While the fox-squirrels have but five teeth on each side in the upper jaw, the adult gray squirrels have in addition another small premolar, making six teeth on each side above. The average length of the gray squirrel is about 18 inches (450 mm.) and that of the northern gray squirrel is about 20 inches (500 mm.). The color of the northern subspecies is given as silvery gray above with under parts white, sometimes rusty on neck or chest. The gray squirrel is dark yellowish, rusty above, the under parts being white.

The habits of the two species are essentially alike, and the following account will apply to both.

The various subspecies of the gray squirrel are distributed throughout the United States east of the great plains, and are found as far north as southern Canada. The southern limit of the subspecies *leucotis* may be indicated by a line extending from the Catskills south of Pennsylvania in the Alleghany Mountains, and thence west through northern Indiana and Illinois.

Under natural conditions this species chooses wooded swamps and river-bottoms, with heavy timber, rather than the edges of the

wooded bluffs and the groves—which are the commonest habitat of the fox-squirrel. Nevertheless, it is the gray rather than the fox-squirrel that is most often semi-domesticated in the parks of cities and the shady streets of towns. A general opinion of both squirrel hunters and other observers of more scientific pretensions seems to be that the gray squirrel, though smaller than the fox-squirrel, drives that species away from such territory as it chooses to occupy itself. Originally this species, like the fox-squirrel, was exceedingly abundant, and at times inflicted great injury on the crops of the farmer. At present, in this part of the country gray squirrels in a truly wild state are very uncommon. In fact, I have no record of one's being seen in the county for a number of years, though there are a few in the adjoining counties. This can hardly be due alone to the thinning of the thick woods. It seems more likely that their gregarious habit has been with them, as with so many other animals, a reason for their rapid destruction by man. The gray squirrel is said to be more prolific than the fox-squirrel, four to six being brought forth in one litter, and at least two litters being produced in a year. I have no proof of more than a single litter.

The most interesting characteristic of these squirrels is the readiness with which they become wonted to parks and the shaded streets of villages where they are not molested. They soon become exceedingly tame, often so much so as to feed from the hand of a stranger, and to enter houses by open windows, even venturing into rooms occupied by persons. They store up, under these circumstances at least, a supply of nuts or other food. Considerable quantities are often found hidden by them in garrets and outbuildings; but they also hide single nuts, etc., under leaves or in the ground, and during the winter may be seen looking for them.

Although they may be seen at any time during the winter if the weather is fine, yet in continued severe weather they do not appear, and presumably are partly torpid and fasting.

The early observers nearly all speak of the extensive migrations of the species in various sections of the country. These migrations usually occurred in the fall. Large numbers would congregate in a locality and then move off in one direction—not indeed in a continuous flock, but rather as individuals, stopping to feed or loiter for some time in a place, but yet moving soon, and always in the one general direction. In these migrations they seemed to be possessed

by the same abnormal disregard of impediments as the lemmings. Though usually averse to taking to water, they would not at such times stop at rivers even though as large as the Ohio or Niagara, and vast numbers were drowned in their efforts to swim across. Although no such migrations of the species have been noticed of late years—owing probably to its diminished numbers—nevertheless the abundance of these squirrels in a given locality at different seasons has been observed to be extremely variable, and it is more than likely that such mass movements do take place though they are not so easily observed as formerly.

The economic status of the gray squirrel is in general the same in all respects as that of the fox-squirrel. Owing to its scarcity in this vicinity it is even more worthy of consideration when in a wild state. In cities and towns, however, when exceedingly numerous, its destruction of birds' nests may call for repressive measures. In such cases a due balance of nature may easily be regained, for the squirrels are easily killed, and there are many who are too glad to do it.

RED SQUIRREL; CHICKAREE.

Sciurus hudsonicus loquax Bangs.

(Proc. Biol. Soc. Wash., X., 1896, p. 161.)

The red squirrel, or chickaree, is not found within the limits of Champaign county. It is said to occur at Onarga, in Iroquois county. It was probably introduced there, but is native in the northern part of the state. Kennicott says that it is found sparingly in heavy timber in Illinois but not in the southern part. We have no data by which to determine the southern limit of its range.

CHIPMUNK.

Tamias striatus lysteri (Richardson).

Sciurus (*Tamias*) *lysteri* Rich., Faun. Bor. Amer., Mamm., I., 1829, p. 181, Pl. 15.

The striped chipmunk (*Tamias striatus*) is found north to New Brunswick and Ontario, west to southern Michigan and Wisconsin, and south to Georgia, Alabama, and Florida, but it is not found on the Atlantic coast plains. It occurs as far west as Kansas, Missouri, and Minnesota. Over this area it is divided into several subspecies.

The average size of the chipmunk is about as follows: Total length, 9.75 in. (250 mm.); length of tail, 4 in. (100 mm.); hind foot, 1.4 in. (36 mm.).

The color of specimens taken in Champaign county is as follows: Hair on chin, throat, belly, and inside of legs creamy white, faintly flushed with buff near the borders. In a small spot behind the ears the hair is dirty white throughout its length. A streak below the eye and one above are buff to the base. The hairs on the under side of the tail are entirely chestnut. On all the other parts the hairs are all plumbeous at base. Over the side of the body the dark base of the hairs is followed by a broad band of buff with usually a minute tip of black, a few of the hairs having broad black tips. Over the rump, the outside of the hind legs, the top of the head, the front of the ears, and in a stripe back of the eye the buff is largely replaced by chestnut or bay. On each side of the body there is a light stripe extending from shoulder to rump. Here few of the hairs have black tips, but, instead, very light buff or creamy white ones. Each side of the light line is a dark one, all the hairs of which are black-tipped. These dark lines are each obscurely banded with a slender line of hairs tipped with chestnut. There is a vertebral line of black-tipped hairs bordered with chestnut-tipped ones, these being continued forward as a faint line which is lost in the chestnut of the top of the head. In the space between the vertebral line and the series of light and dark lines on each side, the hairs are annulated with black and white or light buff, the general effect being a dark gray. The hairs on the upper surface of the tail are banded with plumbeous, chestnut, and black, with a tip of light buff, the general effect being a brownish gray.

The incisor teeth are pale chestnut. The palms are naked and white. The soles of the hind feet are hairy and dark gray.

Chipmunks are not found in the open prairie and are but seldom seen in closely pastured woodland or in prairie groves. The wooded bluffs, and the bottoms down to the usual high-water mark, are their common habitat. They are not often found in the deeper woods, but rather along the edge of the bluff woods, where the trees have been thinned out but where there is still an abundance of old logs, bushes, and brush-heaps. Where the proper conditions exist they are quite numerous, but over a large part of the county they are rare or entirely wanting.

The chipmunk of this part of the country differs strikingly from the New England representative in two respects. In the first place it is far more independent of any such shelter as logs, stones, fences, etc., in choosing a place for its burrow. This is often found in an open spot so near the border of the woods that its owner is a near neighbor to the striped gopher. Then, too, our chipmunk takes to a tree more readily and climbs far more daringly than the eastern one does. Though I have never seen one attempt a leap from branch to branch, it climbs readily to a height of thirty or forty feet, and seems quite at home on the trunk and larger branches, showing none of that uneasiness which Merriam attributes to the chipmunk of the Adirondacks when treed.

I have seen chipmunks pass in and out of holes in hollow trees at a considerable elevation, but have no proof that such cavities were used either for nests or storehouses. The nests are usually at the end of burrows six or ten feet in length, running diagonally down to a depth of two or three feet. If the nest is under a log, stump, or other shelter, the depth may be less. At first the burrows are quite simple, but, later, accessory runways are dug leading to various chambers used as storehouses. Chipmunks are social, a number living together in the same nest.

The food of the chipmunk is largely nuts, acorns, and various small seeds—including corn and grain. It also eats fungi, and is exceedingly fond of berries and other juicy fruits. I find no record of its eating insects or other animal food, but it is a remarkable exception to the other squirrels if it does not do so. It stores up food for winter in underground cavities, and often in surprisingly large quantities. Kennicott took over half a bushel of hickory-nuts and acorns from one such storehouse. It has also been observed to bury stores in a manner similar to that of the other squirrels.

In spite of abundant supplies chipmunks have been found in a semi-torpid condition during the winter. On the other hand, they have been seen abroad by various observers even in severe weather, when there was snow on the ground. Probably the winter sleep is never so deep and so long continued as is the case with the woodchuck or other truly hibernating animals.

Chipmunks, although not rare, are by no means so plentiful in the county as in rougher portions of the country. Undoubtedly the lack of protection afforded by rocks, stone walls, rail fences, etc.,

has something to do with their scarcity. Their enemies are many. Although not used as food they are nevertheless victims of the boy or the bumpkin with a gun. Many are taken by the larger hawks, and cats, weasels, and snakes all help to keep the number down. Being largely day-feeders, it is not likely that night-prowlers catch many of them, though their remains have been found within the stomach of the common screech-owl.

The chipmunk's actions show the result of many generations of constant peril; and if Burroughs's statement that he is never more than a jump from home be a poetic hyperbole, it is true that he is seldom more than one jump from some kind of shelter. In collecting his food or in his play, he moves by fits and starts from one post of observation to another. His curiosity is quite equal to his timidity, however, and though he scampers into his hole at the least sound or sign of a suspicious object, he is pretty sure to peep out in a moment, and the boy with a stone or gun knows that he has only to wait a minute for a chance to throw or shoot.

In the vicinity of cultivated fields a considerable part of the food consists of corn and small grain, with occasional meals of berries or larger fruit; but the real loss sustained by the farmer is very little, for the grain taken is almost entirely waste, gleaned by the industrious little fellow. If chipmunks should become so numerous as to be a pest they are easily trapped, poisoned, or shot. There seems, however, little danger of that in this county, and it seems a pity they might not be left unmolested.

STRIPED GOPHER; THIRTEEN-STRIPED SPERMOPHILE.

Citellus tridecemlineatus (Mitchill).

Sciurus tridecemlineatus (*sic*) Mitch., London Med. Repos., N. S., 1821, p. 248.
Spermophilus tridecemlineatus of Kennicott and various authors.

This little animal is often called the striped prairie-squirrel, and scientists usually prefer the term striped spermophile, since the word "gopher" has been applied to quite a different animal; but the name striped gopher is most generally used and best understood. The term thirteen-striped designates the most striking feature of its appearance. The stripes are made up of six narrow lines of dirty yellowish white alternating with seven broader dark ones, clove-brown in color. These dark stripes are marked by a row of

light spots in the middle. Sometimes—especially in the two outermost dark bands—these light spots run together, dividing the broad dark stripe into two narrow ones. The striped gopher is often confused with the chipmunk, but the slightest attention to these markings is sufficient to distinguish them.

The average size of specimens from Champaign county is as follows: Length, 10.9 in. (277 mm.); tail, 3.62 in. (92 mm.); hind foot, 1.5 in. (38 mm.). This is larger than the measurements usually given. The series measured, however, is a small one.

The gophers are all animals of the open country, avoiding timber, not climbing trees, but seeking refuge in burrows. The range of the striped gopher, under various subspecific names, corresponds in general with the prairie region of North America. In Michigan, Wisconsin, and Minnesota the clearing of the land has brought about prairie conditions, and the species has pushed north beyond the original prairie. The same is true, to some extent, of other directions.

The habitat of this species is always the open. Practically it is never found in woodland, and but rarely in fresh pasture or recently cleared land. On the other hand, it is, within the county, not partial to the extreme prairie type or the till plains, but is far more abundant along the moraine ridges and the portions of the bluff areas that have been long cleared and in pasture. Undoubtedly the area of favorable habitat within the county has greatly increased since its settlement. The species is found in the till plains, especially in localities not under continuous cultivation. Such areas, however, are chiefly limited to borders of fields and a few small pasture-lots. It soon enters a field left down in grass, and also the margins of corn and grain fields. It is rarely found in the middle of such fields. It is found in the cleared pasture also, especially near cultivated fields, but is most abundant in pasture-lots along the crests of the moraines. Here it may be found any summer day so long as the sun is shining.

Like most other non-combative animals living in the open, the striped gopher is exceedingly nervous and timid. The whole existence of these animals above ground seems to be passed in deadly fear of enemies that soar in the air above or lurk in the grass around them. As they creep through the grass they pause every few feet and sit up to look and listen; they crouch low at every passing

shadow, and jump suddenly sidewise, backward, or forwards, as the case may seem to require, from the slightest rustling near them. Of course in reality these actions are for the most part unconscious reactions, their existence requiring, after all, no more watchfulness and dodging than a man must exercise or do in the crowded streets of a great city.

The curiosity of the animal is quite as characteristic as its timidity. Sitting bolt upright at the mouth of its burrow, it will watch an intruder till some noise or motion sets off its unstable reflexes, when it dives into its hole with what seems a half shriek, half chatter of terror. But in a moment it emerges to investigate, and perhaps to repeat the performance. Boys take advantage of this habit of the striped gopher to catch it with a slip-noose. The noose is laid over the mouth of the burrow into which a gopher has just been driven, and with the cord bearing the slip-knot in his hand the boy lies down a few feet away, usually not having to wait long before the gopher puts its head through the noose and is caught.

The young are born about the first of June. The period of gestation is about one month. Lee found the number of embryos in 129 pregnant females varying from 5 to 13, the average being 8.5. The number in a single horn of the uterus varied from 0 to 9. The young are born in an undeveloped condition, and are hairless for about three weeks.

In spite of the remarkable fertility of this species, it does not increase to any great extent in this locality. Its enemies are many. Probably in this county the most important ones are the hawks. Skunks and weasels also kill them, and the fox undoubtedly takes them when nothing more acceptable offers.

I have never been able to detect a striped gopher abroad during the night, though I have spent many hours watching for them. A specimen kept in captivity in a living room could be heard at night stirring in its cage and eating. It may perhaps take a lunch at night in its hole, but I think it does not come out during the middle of the night.

The species is undoubtedly quite dormant during the winter. A specimen kept in a cage in a rather overheated room all winter remained in a sleepy, stupid condition from about the first of November till the last of February. Apparently it partook of food sparingly—only two or three times during that period. For a month

at least before and after these dates it was very stupid, stirring but little. At no time during the winter was it perfectly indifferent to touching, shaking, etc., but responded only by half opening its eyes and making a complaining or angry cry. It appeared to be half asleep, and, left alone, immediately fell into a dormant condition again. The temperature of the room was probably never below 60°, and often about 80°, all winter. Specimens dug out of the ground in midwinter are always fully dormant. In this latitude they remain holed in from October to March inclusive, and are seen but little for some weeks before and after that period.

The exact relation of the striped gopher to the farmer, whether on the whole it does more good or evil, seems to be by no means certain. Although its burrows are abundant at times, they are so small, and, being without accumulations of dirt around the mouth, so inconspicuous that they can do but little harm. Its food, as that of rodents in general, is chiefly of vegetable origin—seeds, buds, grains, and parts of plants of all kinds. The grain that it eats in the fall is probably largely gleanings and represents but little loss to the farmer, being more than compensated for by the seeds of weeds destroyed. A more serious accusation, however, brought against it is that of taking the newly planted corn in the spring. It sometimes follows along the rows of corn just as it is sprouting, eating the kernels and thus destroying the crop. Although a portion of this damage sometimes attributed to the gophers is in reality done by grackles and crows, nevertheless the gophers do considerable injury in that way. On the university farm I have found by actual count about twenty per cent. of the first two or three rows of corn along the side of a field taken by them. This field was next to a piece of land that had been in pasture for some time, and which contained many gophers.

But the gopher, like most of the rodents, is more or less carnivorous, or at least insectivorous. Gillette found as the result of an examination of twenty-two stomachs of gophers taken from April 19 to August 2 that forty-six per cent. of the contents was of insect origin. Some of these insects were predaceous beetles, and their destruction was a loss to the farmer; but there were a larger number of sod worms (*Crambus* larvæ) also found. The writer estimates that an average of twenty-six worms per day were eaten by each gopher between the above dates, or a total of 2730 worms for the

season. Besides these a large number of grasshoppers, wireworms, and other injurious insects were destroyed.* Aldrich's report† on the examination of fifteen stomachs of gophers taken in South Dakota, although not quite so favorable still makes a good showing for the gophers in regard to the number of insects destroyed. I have repeatedly observed them hunting and eating insects. One that I watched, was sitting up eating a big fat grub, biting deep into the juicy, dripping, wriggling dainty, and licking his paws with true epicurean satisfaction when it was finished. There can be little doubt that in this immediate vicinity the good that they do, quite compensates for the damage they may cause.

Hoy found that specimens in captivity were carnivorous, and ate "meadow-mice, flying squirrels, and even their own young." This was undoubtedly due in part to abnormal conditions. White-footed mice and meadow-mice are usually associated with the gopher. I have found the prairie white-footed mouse and the gopher living together in such abundance that it is not easy to conceive of the gophers as habitually feeding on the mice.

If owing to their overabundance, or to other local conditions, the gophers become a pest, no animal is more easily gotten rid of. The readiest and cheapest way to exterminate them over a considerable area is to poison them. If the poison is put into the hole and reasonable care is taken, this may be done with but very little danger of poisoning other animals. They may also be killed by fumes of carbon bisulphid, and in the immediate vicinity of dwellings and barns this may be the most desirable way. They are easily trapped. Often their burrows are shallow, and they are easily drowned out by pouring water into their holes. Finally, the boy with a gun easily decimates them if given a chance.

GRAY GOPHER; FRANKLIN'S SPERMOPHILE.

Citellus franklinii (Sabine).

Arctomys franklinii Sabine, Trans. Linn. Soc., 1822, p. 587, Pl. 27.
Spermophilus franklinii of Kennicott and various authors.

This species, often called the prairie gray squirrel, is found through the northern two-thirds of Illinois, northern Missouri, and

* Bull. Iowa Agr. Exper. Station, No. 6 (1888), p. 244.
† Bull. S. Dak. Agr. Exper. Station, No. 30, pp. 8–11.

eastern Kansas. Thence its range extends north through the valley of the Red River of the North and the Saskatchewan. It is also found in Indiana near the western boundary.

The gray gopher bears a superficial resemblance to the gray squirrel, but the habits of the two are totally different. The tail of the gopher is short, and the hair is sparse and coarse, with no soft under-fur.

The color of the young is as follows: Over the back the hairs are banded buff and black, the banding and arrangement giving the effect of light spots on a dark background; or the spots may be so large and so arranged as almost to form irregular transverse bars of light and dark. Over the head and neck many of the hairs are tipped with pure white, and the general effect is gray. Over the sides the general color is more rusty than on the back. The chin and throat are dirty white. On the belly and inside of the legs the color is dirty buff. The tip of the ear is black within. The inside of the ear and a strip around the eye are ochraceous. The whiskers are black; the claws, horn-color. The hairs of the tail have long, light tips, which are ochraceous at base and whitish near tip. In the older specimens the barring becomes more obscure, and the lighter colors become more rusty and more extensive. The last two-thirds of the tail is gray with a slight flush of ocher.

The total length is about 15.16 in. (385 mm.), the tail is 5.12 in. (130 mm.) long, and the hind foot 2.13 in. (54 mm.).

Early writers describe this gopher as inhabiting the edge of the woods or tracts dotted with low bushes, etc., rather than the open prairie. At present a necessary condition for their habitation seems to be the presence of some shelter, such as may be furnished by tall grass, or a field of clover, alfalfa, or grain. Others have noticed that when the crop on such a field is cut the gophers leave, at least for a while, and my own observations coincide with theirs, though I have known the gophers to return to the same spot after the second crop of alfalfa had started. They avoid closely cropped pastures, well-kept cemeteries, lawns, and similar places where the striped gopher is especially abundant, yet even in such localities I have found them congregated under a heap of compost. In fact such a shelter seems to have special attractions for them, as noted by Bailey. Kennicott says that they are less shy and less disturbed by cultivation of the

land than the striped gopher. My own experience is that while they are perhaps more apt to take up their quarters in the immediate vicinity of barns and farmhouses, they are at the same time far more difficult to approach in the open. They are almost sure to move if the grass or other shelter over their burrows is cut, or if the ground is disturbed by cultivation. They are hence continually shifting their location, often returning to the same place after an absence of some weeks.

There is a common opinion in this vicinity that this species is driven off by the striped gopher. I have never seen the two species together, though very frequently colonies of each may be found within a few rods. I know of no proof as to which can drive off the other.

The species is decidedly gregarious, nearly always being found in colonies. As their burrows each have several openings and these are conspicuously marked by the dirt thrown out, a colony becomes a great nuisance in a hay or grain field. The conspicuousness of these burrows and of the animals themselves has aroused the animosity of the farmers and hastened the destruction of the gophers.

My own data are too incomplete for absolute proof, but I am inclined to believe that a census of the gray gophers in the county would show their abundance in the different habitats to be in the following descending order: moraine bluff, till plain, and cleared pasture. I have never seen them elsewhere, though I presume that they may be found in the borders of woodlands.

The food is largely vegetable, consisting of grain, seeds, and other vegetable matter. The exact nature of this part of the food will of course vary with the habitat, but may be quite largely grain. Bailey, as the result of an examination of twenty-nine stomachs, found that over thirty per cent. of the food was animal matter—largely insects. They are known to kill birds, young chickens, and small mammals, and even gray gopher hair has been found in the stomach.*

They store up grain and seeds for winter, as much as half a peck of oats having been found in a burrow under a shock in September. It seems certain, however, that they hibernate during the middle of winter. They are seldom seen here after October or earlier than

* The Prairie Ground-Squirrels, or Spermophiles, of the Mississippi Valley. Bull. No. 4, Div. Orn. and Mamm., U. S. Dept. Agr., pp. 56, 57.

April. A specimen kept in captivity by Baird did not hibernate, but many other observers have found them quite dormant in winter. Probably the depth and duration of the winter sleep varies with locality and circumstances. They have been known to ascend trees, but such feats are very rare.

Early writers speak of these gophers as being not at all shy. Possibly persecution has made them cautious. They are certainly not easily approached in this vicinity. They are said, however, to be easily tamed in captivity.

Exact and numerous records of the number of young, time of birth, and period of pregnancy are wanting, but so far as available observations go, they indicate that there is one litter a year and that this is smaller than in the case of the striped gopher, containing about four to eight young. They are born in early spring, and remain with the parents during the summer and probably till the next year.

Specimens taken August 9 had reached a total length of 10.5 in. (268 mm.).

In this county the species is seldom abundant enough to constitute a serious economic problem. Compared with the striped gopher it does more damage by eating grain and by covering grain, clover, etc., with the dirt from its burrows. Its burrows, being larger, constitute a disfigurement, and are an annoyance to horses, whose feet may catch in them. There is also a small amount of poultry and eggs charged to their account; but these losses seldom amount to much, while considerable benefit must result from their destruction of insects, especially grasshoppers. In general we believe that the good they do quite balances the harm.

In case they should become a pest they are easily gotten rid of by poisoning, or by any of the other methods applicable to the striped gopher.

Their natural enemies are the larger species of hawks, and skunks and weasels. Cats kill some of them, and a few are killed by man. Like so many other rodents their number in any locality is apt to vary greatly from year to year. This is apparently due to migrations rather than to uneven mortality.

There seems no reason except prejudice why the flesh of this gopher should not be used for food as well as that of the various tree-squirrels. Its food is as clean and its habits are as neat.

WOODCHUCK; GROUND-HOG.

Marmota monax (Linnæus).

Mus monax Linn., Syst. Nat., I., 1758, p. 60.
Arctomys monax of Kennicott and many authors.

The woodchuck is found from Georgia, Alabama, and Kansas north to Hudson Bay and westward to the Rocky Mountains in the northern part of its range, but is not usually at all common in a prairie country. It is rare in this county except in the extreme northern part, where it is said to be not uncommon.

The woodchuck is a thick-set, clumsy animal, with legs so short that the gait resembles that of a fat pig. It is about 22 in. (560 mm.) long, the tail, which is sparingly bushy, being approximately 4 in. (100 mm.) in length. The ears are short. The usual color of the back is grizzly brown, with head, tail, and feet darker; the belly is rusty reddish. Individuals vary greatly, however, some being nearly black, while the light-tipped hair of others gives the animal a light grayish yellow color.

The woodchuck loves a rolling country with a light soil and an abundance of clover, grass, and grain. Given these, woodchucks will more than hold their own with civilization. Through many parts of New England and the Middle States they are probably more abundant now than when the country was first settled. Kennicott, writing of northern Illinois in 1856, says that the woodchuck "was exceedingly rare ten years ago but is now becoming quite common. It is an inhabitant of the woods. I am not aware that it ever lives in the prairie". I found it abundant in McHenry county, and it is said to be equally so in the adjoining counties. It is not now, however, so much an "inhabitant of the woods" as of the cultivated fields where woods stood when Kennicott wrote this. Woodchucks seem never to have been abundant in Champaign county, and at present there are only a few here, these occurring along the borders of the wooded bluffs.

These animals are believed to be strictly vegetarian in their diet.

Their burrows are extensive, and always conspicuous on account of the large quantities of earth thrown out. They do not hesitate to swim across bodies of water, and they do it easily. They have been known to climb low or slanting trees, but this is not usual.

Their young are born in one litter of four to six, in spring. Their winter sleep is profound, and lasts in New England from about

the middle of September to the middle of March. It is probably of somewhat shorter duration here. Like the striped and gray gophers, they sit erect when watching for enemies, and whistle shrilly when alarmed.

The woodchuck is often kept in confinement, but it is a rather stupid and uninteresting pet.

I do not know of any way in which a live woodchuck can be of service to man. The flesh is often eaten by those who like coarse game, and the skin makes a tough leather of limited use. Where woodchucks are abundant they are a serious pest in meadows and grain fields. They beat down the crops, thus rendering harvesting difficult, and the earth they throw out injures the mower or reaper. Their burrows may be stepped into by horses or cattle, and for this reason may be counted dangerous. However, woodchucks are readily gotten rid of. They may be taken in a steel trap set in the mouth of their burrows, or they may be easily poisoned with carbon bisulphid. Moreover, they furnish an excellent mark for practice in rifle-shooting.

FLYING SQUIRREL.

Sciuropterus volans (Linnæus).

Mus volans Linn., Syst. Nat., I., 1758, p. 63.
Pteromys volucella of Kennicott and various authors.

The general range of the flying squirrel is from northern New York south to Florida and west to the plains.

The size of Illinois specimens is about as follows: Total length, 7.8 in. (200 mm.); length of tail, 3.25 in. (83 mm.); length of hind foot, 1.2 in. (30 mm.).

The color above is drab shaded with russet, the base of the hairs being plumbeous; the tail is slightly darker above, beneath buffy gray; the hands, above, are grayish white; and the feet are drab. There is an orbital ring of brownish black and a broad band of the same at the edge of the wing-membrane. The under parts are white, washed with yellow or buff.

The tail is densely clothed with soft hairs, the whole being smoothly flattened, though the vertebræ are of normal form. The eyes are dark and large; the ears, nearly naked and rather large and rounded.

It "flies," in long sailing leaps, by means of an extension of a fold of skin along each side of the body and the neck. There are two parts to this parachute. The larger part extends between the fore and hind limbs, and is held taut by a cartilaginous rod extending from the wrist backward, between the folds of skin, and also by specially developed dermal muscles. The other membrane fills the triangular space between the fore limb and the neck and side of the head. This is held taut by muscles, the chief one of which arises from the zymotic arch and is attached to the rudimentary thumb.

The flying squirrel can not be mistaken for anything else. Of all the mammals found in the county, none is more beautiful or interesting, and yet, considering its abundance, none is perhaps so little known. This is due chiefly to the fact that it is among the most strictly nocturnal of animals—quite as much so as bats or owls—and is, moreover, so quiet and inconspicuous in its movements that it is seldom seen. A nest may remain undiscovered by the passers-by even in a much frequented locality. On the other hand, as there are usually a number of animals in the same nest, the ordinary observer who finds a colony by accident is quite sure to have an exaggerated idea of their abundance. For this reason little reliance is to be placed on popular report of their numbers. I have obtained but few reports and observations concerning the presence of the species in the county; nevertheless, considering how nearly the individuals I have observed escaped detection, I am of the opinion that flying squirrels may be said to be fairly abundant even in the neighborhood of Urbana and Champaign.

Kennicott and the majority of early observers mention deep woods or large groves as the habitat of this species. I have never known of their being found in the groves scattered over the prairie, but they occur in the large woods and in the little clumps of trees that represent the ragged fringing remnant of the wooded-bluff region. Here they are found, several together, nesting in hollow trees.* In other parts of the country they build nests of leaves lined with softer material; or, more rarely, they build them entirely of such softer substances as grass, fine bark, etc. I have no record, however, of such nests within Champaign county, or even within

* I have run as many as fifty out of one den.—Dr. J. Schneck, 1886, Mt. Carmel, Ill.

the state. They also enter houses, dove-cots, etc., and build their nests there.

The food of the flying squirrel includes the usual wide variety of substances eaten by other squirrels—seeds, nuts, buds, etc., and, at least in captivity, beetles and raw flesh. Probably birds and nestlings are sometimes eaten by it.

This species is the most exclusively arboreal mammal we have, never straying far from trees, seldom touching the ground, and never, so far as observation goes, making long runs on the ground or even following fences for any considerable distance. During the winter it keeps to the nest and is more or less torpid. It lays up stores, however, and in captivity is somewhat active during the winter, though it is said to be dull and stupid, lacking entirely the vivacity that characterizes it in summer.

The females are said to produce a single annual litter in April in the northern part of their range, but as many as three litters a year in the South. Data on this point for this county are too meager to be of value. The number in a litter is from three to six.

These squirrels may be said to be gregarious but not social. The family remains together for a considerable time, and possibly others join it. At least quite large colonies are found living in the same tree. They are not quarrelsome, but in their work and their play they exhibit a remarkable indifference to each others' presence, each sporting by himself without regard to the others. The mothers, however, show remarkable devotion to their young.

Nothing can be more elusive than the flight of this squirrel when first seen. Even if the eye is fortunate enough to note the start, as the squirrel leaps from a tree in a long, swift, silent glide, the quick upward turn is sure to bewilder and make one lose sight of the animal. There is a striking resemblance between this quiet gliding downward of the squirrel and the floating of a leaf. There is said to be a slight tremulous motion of the fore limbs during the glide, but it is difficult to see what function this may have in the movement of the animal.

The flying squirrel has three quite diverse calls or cries. It utters the usual "chuck-chuck" of squirrels, the usual quick, sharp squeak when scolding, and also, more rarely, a clear musical note, commonly melodious and pleasant, but occasionally shrill. This

resembles the chirp of a bird, and may be kept up for ten minutes at a time.

This squirrel is one of the most easily tamed of all our wild animals, none of which are more gentle and interesting. The captive may usually be trusted to run about the room without making any effort to escape. However, if given too much liberty, according to my experience, some day, with no apparent reason and when least expected, there is a dash for liberty, and the squirrel is gone for good. The playfulness of these little animals, their gentle, graceful beauty, and their wonderful vivacity make them most delightful pets.

BEAVER.

Castor canadensis Kuhl.

(Beit. Zool., 1820, p. 64.)

The beaver seems to have been practically exterminated in this part of the state before the first permanent settlers came. There was an extensive dam on the South Fork a few miles above Urbana, and several others, less generally known, on the lower part of the Salt Fork. There is probably not a wild beaver in the state at the present time.

BLACK RAT.

Mus rattus Linnæus.

(Syst. Nat., I., 1758, p. 61.)

The black rat is mentioned by early travelers as existing in the river towns in the southern part of the state. It is extinct at present so far as known.

BROWN RAT; NORWAY RAT.

Mus norvegicus Erxleben.

(Syst. Regn. Anim., I., 1777, p. 381.)

Mus decumanus Pallas, Nov. Sp. Quad. Glir., 1778, p. 91.

This is the only species of rat found in the county, and probably the only one now in the state. Like the house-mouse, it has become cosmopolitan. I have never myself seen the animals or identified their burrows in open fields, borders of woods, etc., except in the im-

mediate vicinity of some extensive artificial shelter, such as a compost heap, straw stack, or the like. Undoubtedly there are individuals leading a wild life, but they can not be abundant. There have been instances of rats' becoming so abundant in the fields as to be a decided pest. For example, in the summer of 1903 immense numbers appeared in several counties of western Illinois, especially in Mercer and Rock Island counties, and were a veritable plague during that and the following year.* I have never heard of a similar visitation in this county. It is pretty well established, however, that the appearance of vast numbers in a locality where they have not been known to be excessively abundant before is due to continued conditions favorable to the increase of the species, and is therefore liable to occur in any locality where the species is fairly abundant.

Rats are exceedingly fertile. They breed three to five times a year, and a litter varies in numbers from six to twenty. The period of gestation is twenty-one days. A female rat can breed when less than three months old. The young are brought forth in a very undeveloped condition, being hairless, with eyes closed and the outer ears glued down over the orifice.

The rate of reproduction varies with the climate and the food supply, a moderate temperature and an abundance of food increasing both the number of litters a year and their size. Extensive investigations made in connection with the United States Biological Survey indicate that the average for well-fed individuals in this latitude can not be less than ten to a litter. At this rate, supposing there were only three litters a year, if a single pair and their progeny should breed uninterruptedly for three years, and no deaths occur, the total number resulting would be something over 20,000,000 individuals.

There is no mammal in the state against which so much that is injurious can be proven, and for which so little of good can be claimed; and the whole economic problem so far as the rat is concerned, reduces itself to determining how to exterminate it most rapidly and satisfactorily. Since, in spite of their great fertility, rats are not increasing rapidly, it is evident that there must be many agents naturally tending to their destruction, for very few of them, comparatively, are killed by man under ordinary circumstances.

* Lantz, D. E. "The Brown Rat in the United States." Bull. No. 33, Biol. Surv. U. S. Dept. Agr., p. 17.

Of all these natural enemies the weasel is probably the most destructive. This little carnivore seems to have taken upon itself the regulation of overproduction among all the *Rodentia*. Skunks and foxes also make way with many of them. The larger owls kill many rats, and are probably responsible for killing more of them than any other animal except the weasel. The larger hawks also catch them occasionally, and are undoubtedly an important factor in checking any overabundance of rats in the fields.

Although comparatively rare in the fields, the damage done within the county by rats in the immediate vicinity of man's abode must amount to many thousand dollars each year. The heaviest loss is probably in granaries, elevators, and various other storehouses for grain or for flour or vegetables. They are very destructive to young poultry. Probably no small part of the loss of this kind commonly attributed to weasels and skunks is due to rats. They are also great thieves of eggs.

Of late, attention has been called to the fact that destruction of property by rats is the least important of their evil deeds. Far more serious is their agency in the spreading of infectious disease. The bubonic plague is spread entirely by means of the rat flea. Trichinosis among swine is perpetuated, so far as is known, entirely by rats. Trichinæ can only occur in hogs as a result of their eating the flesh of some infected animal, and the rat is the only other animal with which the hog comes in contact that is so infected. As they frequent in turn sewers, outhouses, granaries, storehouses, and pantries, they may also disseminate such diseases as typhoid, dysentery, and tuberculosis.

HOUSE-MOUSE.

Mus musculus Linnæus.

(Syst. Nat., I., 1758, p. 62.)

The common house-mouse has followed the European races of man into all parts of the globe. So far back as the time of Kennicott's papers on the mammals of Illinois (1856–1857) it had become frequent in the fields, digging burrows and laying up stores in them. It is very abundant in harvest fields in late summer and fall, often far outnumbering all the other species of small mammals taken together. At that time traps set inside shocks of grain or corn will

often catch but little else. There seems to be an irruption of these mice into the field after the crop is cut. Traps set under shocks just put up will catch none of the mice, except perhaps near a barn or other shelter, but later the mice may be taken under shocks farther and farther out in the field, and within a fortnight they may be found in the center of an eighty-acre lot. As noted on page 505, they apparently drive the white-footed prairie-mouse away from the shocks. During most of the year house-mice are not commonly found in the woods or open fields except under some sort of artificial shelter. It is curious to note how a refuse dump, a compost heap, a pile of old boards, a haystack—whatever is the work of man's hands or the remains or refuse of his habitations—attracts these mice. In the middle of an extensive sand area in Mason county a few bits of boards and a bushel or two of old tin cans and broken pottery gave shelter to a colony of house-mice, though a full half mile from anything else that could have protected them. Bailey reports finding them in Texas on a deserted ranch a hundred miles from the nearest railroad town.*

There is considerable variation in color in this species within the county. The general mouse-gray is usually modified to a greater or less degree by a flush of orange-yellow—"varying through smoke-gray and drab-buff to near orange-buff." One gets all these variations in a single locality and among specimens taken on the same date. I have not been able to correlate these variations with any ecological factor.

WHITE-FOOTED WOOD-MOUSE.

Peromyscus leucopus noveboracensis (Fischer).

(Osgood, N. Am. Fauna, No. 28, 1909, p. 117.)

Mus sylvaticus novcboracensis Fischer, Synop. Mamm., 1829, p. 318.
Mus leucopus (Raf.), Kennicott.

The range of this subspecies is from Nova Scotia to central Minnesota, thence south through the humid parts of eastern Nebraska and Kansas, and eastward to the Atlantic coast.

There is considerable variation in size, as shown by the following table.

* N. Am. Fauna, No. 25, p. 92.

No. of specimens measured and places of capture	Average length								Ratio of length of tail to length of head and body
	Total		Head and body		Tail		Hind foot		
	in.	mm.	in.	mm.	in.	mm.	in.	mm.	
178, whole state..	6.42	163.8	3.56	90.3	2.89	73.5	.79	20	80.3
96, Champaign Co.	6.53	165.7	3.55	90.2	2.97	75.5	.79	20	83
28, Olive Branch, southern Ill	6.11	155.3	3.43	87.2	2.68	68.1	.79	20	78

This table indicates that the specimens from the southern part of the state are rather smaller, and their tails both absolutely and comparatively shorter, than those from this county. The specimens from Olive Branch were all taken the last week of December and the first of January.

The color varies with the age and the condition of the coat. In all specimens, however, the hairs of the feet and chin are white to the base. Very rarely a few dark hairs are found below the wrist or ankle. The hairs on the belly, throat, and inside of the legs are white except for the plumbeous base. In immature individuals the general color on the sides is hair-brown slightly warmed with ochraceous. Toward the dorsal line this becomes darker, being nearly blackish slate over the back. This coloration is often quite indistinguishable from that of the white-footed prairie-mouse. In the brightest-colored mature forms the majority of the hairs on the upper parts are tipped with warm ochraceous buff, but mingled with these are black-tipped ones, producing the general effect of Vandyke brown over the back, while the sides are paler. All shades possible between these brighter hues and the general color of immature specimens may be found among adults. Part of this variation is probably due to the fact that the ochraceous tips of the hair fade or wear off as the pelage becomes shorter. The tail is usually bicolor—mouse-gray to dark sepia above, white below. The ears are large, thin, and dusky except at the margin, which is very narrowly bordered with white.

This species is very similar to the white-footed prairie-mouse, but is larger, the feet pure white, no black hairs occurring on them, and the tail is longer than that of the prairie white-foot. The length of the tail vertebræ divided by the length from the tip of the nose to the base of the tail gives a ratio that will serve to distinguish the two species. This ratio is .7, or over (usually .75 to .9), for the woodland white-foot, and under .7 (usually .6 to .65) for the white-footed mouse of the prairie.

The common name of this mouse is especially appropriate, as the habitat of the species is practically coextensive with the woodland areas of the state, present or past. I have taken it in a clump of bushes, hardly three rods square, standing alone in the prairie some miles from any timber, but I do not often find it following fences or hedges unless these are near areas recently wooded, and it does not usually make its nests or burrows where there is no shelter.

I give below the per cent. of specimens taken in the different habitats in this part of the state.

Till plains,	5 per cent.	Flood-plain,	35 per cent.
Moraines,	4 per cent.	Groves,	33 per cent.
Bluffs,	13 per cent.	Cleared pasture,	10 per cent.

These figures indicate in a general way the relative abundance of the species in the different situations. As much more trapping was done on till plains and moraines than in the other localities, the percentages given for those two are too high to denote relative abundance. In the fall and winter I find this species in the deepest woods still standing in the county. I have also found it in heavy timber of beech, maple, and oak on the hills in the southern part of the state. During summer these mice leave the thick woods and are found along the borders of woodlands; in pastures where there are stumps, brush, or other shelter; and especially along the margins of brooks and on flood-plains. They are not found on till plains or moraines except in the neighborhood of timber or where there is a clump of bushes or similar shelter. Shocks of corn or grain near groves or other woodland may be occupied by them.

This species and the prairie white-foot, though often found within a short distance of each other, do not mingle. I have taken the house-mouse and woodland white-foot under the same pile of boards; and the house-mouse and the white-footed prairie-mouse under the

same corn shock; but I have never found the prairie-mouse and the woodland one living together in such manner.

This mouse usually builds its nest under stumps, logs, or similar cover. Its burrows are little more than passageways under such cover, lying, at most, but a few inches under ground. I have never found a burrow of this species in the open without protection. Occasionally the nest is made in a wood-pile, or in an old stub or tree some feet from the ground. I saw one in a decaying apple-tree four feet above the ground. Hoy reports having seen nests at a height of eight to ten feet in the branches of thorn-trees (*Cratægus*) in southern Wisconsin. The nests are made of leaves, fine grass, etc.

The food of this species is vegetable matter—seeds, nuts, grasses, and herbage. In captivity, according to Merriam, it will eat flesh and catch flies and eat them. Other observers have failed to induce them to eat any flesh. They may store up food for winter, as nuts, grains, seed, etc., have been found in their storehouses, sometimes in considerable quantities. They do not hibernate, but are active all winter, and their tracks are often seen in the snow.

The following table shows the result of an examination of fifty-five females.

Date	Accessions number	Condition of female.
Jan. 1.....	37921	Parturition shortly before.
Jan. 1.....	37922	Four embryos—full grown.
Jan. 1.....	37923	Two embryos—full grown.
Jan. 2.....	37931	Uterus shrunken and empty.
Jan. 2.....	37932	Uterus small, empty.
Jan. 2.....	37933	Three small embryos.
Jan. 2.....	37934	Uterus small, empty.
Jan. 2.....	37936	Uterus small, empty.
Jan. 2.....	37939	Uterus small, empty.
Jan. 2.....	37941	Recent parturition.
Jan. 3.....	37954	Uterus small, empty.
Jan. 3.....	37955	Uterus small, empty.
Feb. 14.....	38342	Uterus medium-sized, empty.
Apr. 4.....	37983	Three embryos—size of peas.
Apr. 18.....	37989	Uterus swollen, empty.
Apr. 18.....	37991	Four embryos—nearly grown.
May 11.....	13829	Four embryos—three-fourths grown.

Date	Accessions number	Condition of female
May 26.....	37927	Uterus small, empty.
June 17.....	38373	Recent parturition.
June 26.....	38387	Uterus empty.
July 1.....	38395	Uterus small, empty.
July 1.....	38399	Five very small embryos.
July 1.....	38402	Four embryos—full grown.
July 1.....	38404	Uterus small, empty.
July 3.....	37794	Four embryos—nearly grown.
July 10.....	38412	Parturition recent.
July 10.....	38415	Uterus small, empty.
July 10.....	38417	Uterus small, empty.
July 16.....	38419	Uterus small, empty.
July 28.....	38440	Uterus medium-sized, empty.
July 28.....	38442	Uterus medium-sized, empty.
July 29.....	38449	Uterus medium-sized, empty.
Aug. 18.....	38478	Embryos present but minute.
Sept. 12.....	37839	Nursing.
Sept. 13.....	37840	Small embryos, 2 mm. long.
Sept. 19.....	37841	Uterus minute, empty.
Sept. 19.....	37842	Five-embryos—nearly grown.
Sept. 19.....	37843	Uterus large but empty.
Sept. 20.....	37847	Uterus shrunken and empty.
Sept. 20.....	37848	Five embryos—nearly grown.
Sept. 20.....	37848a	Recent parturition.
Oct. 1.....	37877	Uterus small, empty.
Oct. 2.....	37881	Uterus small, empty.
Oct. 2.....	37883	Uterus small, empty.
Oct. 16.....	37890	Uterus small, empty.
Oct. 17.....	37899	Recent parturition.
Oct. 17.....	38201	Five embryos—full grown.
Oct. 17.....	38204	Uterus small, empty.
Oct. 17.....	38206	Uterus small, empty.
Oct. 31.....	38250	Uterus medium-sized, empty.
Oct. 31.....	38626	Uterus shrunken, empty.
Nov. 1.....	38257	Parturition recent.
Nov. 13.....	38279	Uterus medium-sized, empty.
Dec. 31.....	37913	Uterus empty.
Dec. 31.....	37915	Uterus small, empty.

An examination of the table shows that young are born at all times of the year from January to October inclusive. It would seem likely that the same individual might produce three litters a year. The number in a litter is rather small, varying from two to five, with an average of a little less than four.

Apparently the sexes are separated during a good part of the year. At any rate the specimens caught during a night in a limited area almost invariably show a great preponderance of one or the other sex.

Although these mice are supposed to be nocturnal in their habits, Fisher has shown that a number of them are taken by hawks.* Many are caught by owls, which, with weasels, skunks, and snakes, are probably their chief enemies in this vicinity.

Although these mice are undoubtedly the most numerous mammals in the county, from an economic standpoint they are probably of little importance. They enter grain and corn fields and nest under the shocks, but the grain or corn eaten at first is usually waste. If, however, corn is allowed to remain in the shock till late in the winter, considerable damage may be done to it by these mice. They are said to enter barns and granaries in winter. A few such instances in this state have come to my notice.

WHITE-FOOTED PRAIRIE-MOUSE.

Peromyscus maniculatus bairdii (Hoy and Kennicott).

Mus bairdii Hoy and Kennicott, Kennicott, Agr. Rep. Comm. Patents, 1856, pp. 92–95, Pl. XI.

Peromyscus michiganensis of authors, not of Audubon and Bachman.

According to the recent arrangement of the genus by Osgood the *maniculatus* group, containing some 30 forms, is scattered over various parts of North America from the arctic plains on the north to the central part of Mexico on the south. The form *bairdii*, of which the type locality is Bloomington, McLean county, Illinois, is said to have the following range: "Prairie region of the upper Mississippi Valley in southern Wisconsin, Minnesota, Illinois, Indiana, eastern Ohio, Iowa, Missouri, Oklahoma, and the eastern or humid parts of

* "The Hawks and Owls of the United States," Bull. No. 3, Div. Ornith. and Mamm., U. S. Dept. Agr.

Kansas, Nebraska, South Dakota, and North Dakota; north to southern Manitoba."*

The following table gives the measurements of specimens from various localities.

Number of specimens measured and places of capture.	Average length						Ratio of length of tail to length of head and body
	Total		Head and body		Tail		
	in.	mm.	in.	mm.	in.	mm.	
71 from Champaign county...	5.28	134	3.27	83	2.01	51	.63
30 from Illinois outside of Champaign county.....	5.24	133	3.19	81	2.05	52	.64
47 (Coues') chiefly from Wisconsin and Illinois.....	4.96	126	2.95	75	2.01	51	.68

It should be noticed that the specimens of Coues were apparently measured as alcoholics. If that be the case, the fact will explain the shorter body and the consequent greater ratio of tail to body-length in his measurements.

The maximum total length I have found, is 149 mm. The average length of the hind foot for specimens in the county is 17.6, and the outside height of the ear averages 13.6 mm. The ratio of the length of the tail to the length of the body, which gives one of the most constant distinctions between this species and *P. leucopus*, generally lies between .58 and .65. In a few cases it lies below these limits, but in only five instances in one hundred and fifteen specimens did it rise to .70.

In all immature and many mature specimens the general color over the upper parts is dark gray with a shade of umber, giving a tint much resembling wood-brown of Ridgway's nomenclature. This is darker towards the back, becoming nearly black along the middle line from the nape to the rump. The cheeks and back of the ears are smoky gray, as is also the upper surface of the tail and the

* Osgood, W. H., in "Revision of the Mice of the American Genus Peromyscus." N. Am. Fauna, No. 28, p. 79.

area around its base. The belly, chin, throat, inner side of legs, under side of tail, and usually the toes, are white. The white of the feet is modified to a greater or less degree by black hairs, producing a grayish color. The ears are sparingly covered with short dusky hairs. About one half the whiskers are white.

In older specimens the color of the upper part is warmed with a burnt-umber shade; the cheeks, back of the ears, and a line along the side and around the base of the tail become fawn-color; and the whole back is warmed to a greater or less degree, often quite equaling the average *P. leucopus* in liveliness of color.

Close examination will show that the base of the hairs is in general dark plumbeous, the only exception being the hairs of the toes, chin, and under side of tail, which may be white to the base. The tips of the hairs over all the under parts are white. Over the upper parts there are long hairs tipped with black or dusky, and shorter hairs which may acquire more or less of fawn or umber at their tips. The colored tips of those nearest the middle line are commonly paler and shorter than those of the side, while the black hairs are more abundant along the middle of the back. The upper surface of the tail may remain dusky or acquire a slightly umber tone. The feet usually become more nearly pure white with age.

Within the county this species is practically limited to the till plains and the highly cultivated areas of the moraines. It is emphatically an inhabitant of the open fields, differing from the preceding species far more noticeably in its habits than in its structure. It is the most characteristic mammal, and the most abundant one, of the great fields of the till plains. During late winter, spring, and early summer it is nearly the only mammal resident in the center of the great corn and grain fields of the county. Other species frequent the edges of the fields or enter them in fall when the grain is ripe, but this species is apparently present in the very center of the largest fields, even during those months when, owing to vigorous cultivation, the conditions seem most unfavorable.

The following table illustrates the local distribution of the species according to habitat.

	Champaign county	Elsewhere in state	Total
Taken in Till Plain	47	5	52
Moraine	10	2	12
Bluff	1	0	1
Flood-plain	1	0	1
Woodland	0	0	0
Pasture	0	4	4
Total	59	11	70

So far as my own experience goes I have never taken a specimen in woodland, or under stump, brush-heap, or other cover than such a temporary one as a shock of corn or grain, and even here one is quite as successful if traps are set in the rows between the shocks as if set under them. Others report their nests under boards, fence rails, logs, etc., but the only nests that I have found that were undoubtedly of this species, were in burrows in open fields. The burrows are small, about 2 cm. (.8 in.) in diameter. They descend perpendicularly about 10 cm. (4 in.), then run horizontally, for perhaps 50 cm., to the nest. This is composed of nibbled straw or grass. They store up seeds and grain in these burrows. They do not hibernate, but are certainly more or less active all winter.

An examination of a limited number of stomachs indicates that when seeds, grain, fruit, and other available vegetable food is present, their diet is varied but strictly vegetarian. Specimens taken in the center of large, well-cultivated corn fields, however, where there was little vegetation except the young growing corn, had resorted to an insect diet. While they undoubtedly do eat grain, still, even when that is present, it constitutes only a part—and apparently the smaller part—of their food. In illustration of this, I may mention a nest found in the stubble of an oat field which contained a store of grass seed but no oats. Again, the stomach of a specimen taken in late fall in a corn field where there was abundance of fallen corn, showed on examination that 25 per cent. of the contents was undigested seeds of a ground-cherry (*Physalis lanceolata*);

hence over 50 per cent. of the bulk of the food was probably the fruit of that plant. Many similar illustrations could be given.

Kennicott says that white-footed prairie-mice injure young fruit-trees by gnawing at the roots. It is possible that when young trees are set out on the prairie this might happen, though even then I should be inclined to suspect that a meadow-mouse was the culprit till it was proven otherwise. In any case this species does not seek nurseries, small-fruit patches, etc. Even in a cemetery in which they were very abundant in open places, I have never taken them in the neighborhood of shrubbery.

An examination of 24 females made to determine time of breeding, number in litter, etc., gave the following result.

Date	Accessions number	Condition of female.
Feb. 16.....	38349	Uterus small, empty.
Feb. 19.....	37858	With 2 young, 81 mm. long.
Feb. 23.....	37110	Pregnant; 4 small embryos.
Mar. 26.....	37977	Nursing.
June 11.....	38359	Five embryos.
Aug. 30.....	38603	Uterus small, empty.
Oct. 3.....	39606	Uterus empty but swollen.
Oct. 3.....	39607	Six embryos, 2 mm. long.
Oct. 26.....	38228	Uterus small, empty.
Oct. 26.....	38230	Uterus small, empty.
Oct. 30.....	38236	Nine embryos.
Oct. 30.....	38239	Uterus empty, mammæ large.
Oct. 30.....	38240	Seven embryos, half grown.
Oct. 31.....	38246	Seven embryos, a fourth grown.
Oct. 31.....	38249	Six embryos, nearly grown.
Nov. 5.....	39635	Five embryos, nearly grown.
Nov. 5.....	39638	Uterus empty but swollen.
Nov. 10.....	38269	Uterus small, empty.
Nov. 10.....	38270	Four embryos, very small.
Nov. 14.....	38286	Uterus empty.
Nov. 20.....	39652	Uterus empty.
Nov. 20.....	39654	Uterus empty.
Nov. 30.....	38295	Uterus small, empty.
Nov. 30.....	38296	Uterus small, empty.

This would seem to indicate that there are three broods a year at about equal intervals of four months; viz., in the latter part of February, in June, and in October.

The number in a litter varies from four to nine. This agrees in general with such records as have been made by other observers. The young adhere to the teats with considerable tenacity, and have often been seen clinging to the dam when the nests were disturbed. The smallest specimen found pregnant was 129 mm. in total length. The average length of all my specimens being 134 mm., I am inclined to believe that they breed first when about one year old.

The enemies of this species, as of the white-footed wood-mouse, must be the nocturnal *Carnivora* found in the open fields, viz., skunks, weasels, and owls. Very few have been found in the stomachs of hawks.

Economically their importance seems to be small, for good or ill. I have no record of their injuring growing crops in this locality, and the grain taken, while perhaps considerable in total amount, is chiefly waste. The species does not habitually feed on grain in shocks, and so far as any available record goes it never enters barns or granaries.

Owing to the clearing of woodland and the drainage of waste tracts, the area of its habitat within the county has undoubtedly greatly increased since the settlement of the country, and, considering its advantageous adaptation to the present state of cultivation, it seems quite certain that there are more individuals within our limits now than when the country was unsettled, and that its numbers are not diminishing at present.

SOUTHERN GOLDEN MOUSE.

Peromyscus nuttalli aureolus (Audubon and Bachman).

Mus (*Calomys*) *aureolus* Aud. and Bachm., Proc. Acad. Nat. Sci. Phil., I., 1841, pp. 98–99.

A few specimens of a golden mouse identified by Osgood as probably of this form, were taken near Olive Branch, Alexander county, in the extreme southern part of the state. They were quite abundant in the low woods of oak bordering the cypress swamps. Kennicott reported it from Murphysboro, in Jackson

county, and from Salem, in Marion county. The latter locality is probably near the northern limit of its range.

The golden mouse is easily recognized by its color, which is a rich tawny-ochraceous above and creamy white below. Nothing seems to be known of the habits of this most beautiful animal. I found it living with the white-footed wood-mouse, both being taken under the same log; but while the wood-mouse was taken also on the wooded hills in the vicinity, the golden mouse seemed to be limited to the low woods bordering the swamps. Kennicott says that the golden mouse takes to a tree readily when pursued, and that in the vicinity of Salem it often built nests in the branches of low trees. Its nests "were like birds' nests, but covered at top, with a small opening on the side."

FLORIDA WOOD-RAT.

Neotoma floridana (Ord).

Mus floridana Ord, Bull. Soc. Philom. Paris, 1818, p. 181.

There is a single specimen of this species in our collection, taken by A. Hempel at the Quiver Cut-off, at Havana, Ill., July 17, 1895. It was found in a log on shore.

This wood-rat closely resembles the common brown rat in appearance, but the color on the back and sides is rufous, and the feet are pure white. In the southern part of the United States it is said to be common along streams. According to Knox,* "They build nests by piling up sticks and pieces of bark, to the height of two or three feet, often about the base of a tree or stump. In the middle of these piles they have a nest of dried grass and leaves."

Kennicott published a plate of the wood-rat † but gave no information in regard to it. I find no record of its occurrence within the state.

*"Kansas Mammalia," Trans. Kan. Acad. Sci., Vol. IV., p. 21.

†Trans. Ill. State Agr. Soc., Vol. II., Pl. XIV.

PENNSYLVANIA MEADOW-MOUSE.

Microtus pennsylvanicus (Ord).

Mus pennsylvanica Ord, Guthrie's Geogr., 2d Am. ed., II., 1815, p. 292.
Arvicola riparius Kennicott, Trans. Ill. State Agr. Soc., II., (1856–57), p. 677.

This species was called the long-haired meadow-mouse by Kennicott. It has not yet been found in Champaign county. There are several specimens in the collections of this Laboratory that were taken near Normal, in McLean county, and I took two specimens in a tamarack swamp in McHenry county.

Like the prairie meadow-mouse, this species rarely leaves the shelter of dense low-growing vegetation. It is found in wet meadows, in waste corners of cultivated fields, and in woodlands and wooded swamps. Its nests are said not to be in burrows but under stumps, logs, etc. In winter it is sometimes found on the surface of the ground, with no cover but the deep snow. In such situations the heat of the animal forms a large dome beneath the snow, and from this many runways extend in all directions. When the snow thaws, these nests are deserted. The underground burrows of this mouse are shallow and simple, often not extending beyond the log or other cover under which they are dug.

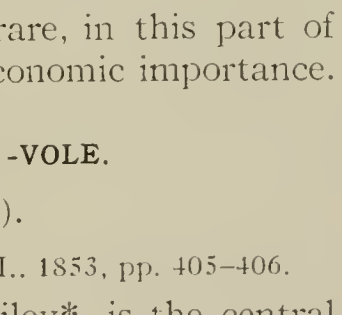

Fig. 1. Molar enamel pattern of Pennsylvania meadow-mouse. (Bailey.)

The species is said to breed from March to November inclusive. There are probably three litters of five to eight in a year.

The economic relations of this species are similar to those of the prairie meadow-mouse, but the species is so rare, in this part of the state at least, that it has practically no economic importance.

PRAIRIE MEADOW-MOUSE; PRAIRIE-VOLE.

Microtus austerus (Le Conte).

Arvicola austerus Le Conte, Proc. Acad. Nat. Sci. Phil., VI., 1853, pp. 405–406.

The range of this species, according to Bailey*, is the central part of the Mississippi Valley, from southern Wisconsin to southern Missouri and Fort Reno, Oklahoma, and west into eastern Nebraska and Kansas.

* "Revision of American Voles of the Genus Microtus," N. Am. Fauna, No. 17, p. 73.

The average measurements for 29 specimens, most of them from this county, are as follows: Total length, 5.47 in. (139 mm.); tail, 1.22 in. (31 mm.); hind foot, .75 in. (19 mm.). There is considerable variation in the length of the tail, our specimens ranging in this respect from 1.02 in. (26 mm.) to 1.58 in. (40 mm.).

The upper parts are dark gray, with a peppery appearance due to the mixture of black and pale fulvous tips of long hairs, the black-tipped ones predominating. The sides are paler, the belly is washed with pale cinnamon, and the tail is bicolor. The base of the hairs is everywhere plumbeous.

Kennicott regards this species as the most abundant native mammal on the prairie of northern Illinois. In this county I think that it is outnumbered on both till plains and moraines by the white-footed prairie-mouse, and in many localities, during the autumn, by the common house-mouse. It is, however, very difficult to estimate the number of these mice present in any area. They seem to possess the same migratory instinct as their near relatives, the lemmings, frequently moving from place to place. At any rate, in common with other observers, I have often taken them in comparative abundance in a locality where the year before or the year after not a specimen could be obtained by prolonged trapping. There is also a temporary shifting to grain and corn fields in fall and late summer, and a return to the shelter of fences, edges of woods, etc., in winter. Kennicott describes the species as being most decidedly an inhabitant of the prairie, and declares that he has never found it in the woods; while observers in other localities report it as having a most decided preference for the edge of woodlands or open groves. So far as my own observation goes, it is the ground-cover which determines the habitat of these meadow-mice. They are not found in closely grazed pastures nor in well-cultivated fields of corn, vegetables, etc., but they may occur wherever there is a close growth of grass or other low vegetation. Where this condition prevails I have taken them in groves and in fairly dense and extensive woods, though their favorite situations are the waste places along fences, in the corners of fields, and in permanent pastures. They are also abundant at times in alfalfa and clover

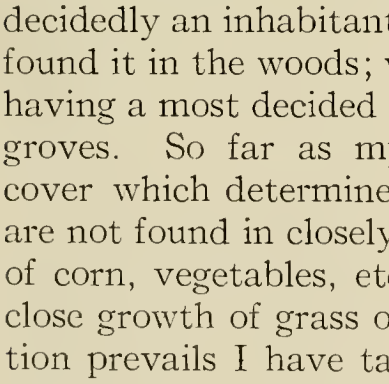

Fig. 2. Molar enamel pattern of prairie meadow-mouse. (Bailey.)

fields. When grain or corn is shocked they soon take up their residence under the shocks.

While not more than a single family is found in a nest, they are usually so associated that they may be abundant in one limited locality though entirely wanting in a similar one near by.

They are found on the margins of the flood-plains down to the border of the sedge zone, but they do not enter that zone as a usual thing. Although always more numerous on high ground, they are also found in considerable abundance along the borders of the flood-plains, and are often driven out of their burrows there by the spring floods. At such times I have found them clinging to stumps and other objects that rose above the water. On my approach they would take to the water, swimming easily, and diving and escaping if pursued.

The habits of this species were studied and well described by Kennicott in northern Illinois forty-five years ago, and we can do little more than confirm his observations. The presence of these mice is always indicated by their runways through the grass. They seldom move by leaping, but creep close to the ground, keeping under cover whenever possible. Similar runways are sometimes made by the white-footed mice and shrews, but theirs are much the longer and more extensive, as those species do not object to running out in the open. The runways are about one and a half to two inches in diameter, and it is said that the mice make them by biting off and beating down the grass. The runways communicate with burrows four to eight inches below the surface, which may form an intricate network. The nests may be built above ground or below. They are globular in shape, about six inches in diameter, and are entered from below. They are constructed of soft grass. Those which are built below the surface are for winter use, though under haycocks and similar shelter the mice are found in winter occupying nests above ground. Often a nest so located, with its associated runways, is in close connection with a subterranean nest, which is also connected with a mesh of subterranean runways lying below those on the surface.

These meadow-mice do not hibernate, though they store up considerable supplies of food. This consists of grass and various roots. Kennicott found in their burrows roots of *Liatris*, *Helianthus*, *Silphium*, wild onion, and grasses.

In many localities this species undoubtedly does the most damage of any of our smaller mammals. An extensive investigation by the U. S. Department of Agriculture showed that immense damage was done at times, in various localities, by field-mice of this and closely related species. They destroy shocked grain and corn; they eat roots when stored in heaps, or even when growing; and they destroy clover, alfalfa, and grass in meadows. But perhaps the most common and grievous complaint made against them is that they girdle young trees, especially in orchards and nurseries. They have been charged in this county with all these classes of injury. However, conditions here are not such as to render the farmer liable to extensive damage by these pests. Corn is not often shocked, grain is usually threshed very shortly after cutting, and as meadows are seldom kept in grass for many consecutive years the mice do not get well entrenched in them. Again, but little attention is paid to fruit-raising, and so there is no great damage to fruit-trees. Perhaps, in this county, truck-farmers and growers of small fruit suffer more loss from this mouse than any other class. In an adjoining county I have seen fields that had been kept in clover for two or three years abundantly infested by these mice, considerable damage to the crop resulting. They are hardly numerous enough with us at present to be denominated a pest, but their record in other localities shows how easily, under favorable circumstances, their numbers may so increase as to render them a serious menace to the farmer.

So far as I know, no claim can be urged in their favor except the rather dubious one, put forth by Rhoads, that they furnish food for hawks, owls, and carnivorous mammals. It is true that their favorite resorts are usually the waste places neglected by the farmer, that the green food they eat would not be utilized otherwise, and that a large part of the grain they destroy is waste; but, nevertheless, to the grower of garden-truck and fruits their presence is always a menace, and any signs of their unusual abundance should be regarded as a call for prompt action.

The field-mice demand a close cover of soft, low-growing herbage for their nests and runways. Where there is a heavy snowfall which lies undisturbed for weeks, they venture out under it into fields bare of vegetation, but such conditions are rare in this county.

The most favorable place for trapping meadow-mice is a broad strip of unkept sod along a fence between two corn or grain fields. Waste spots in permanent pastures next to cultivated fields are also favorite localities; but where weeds and grass are kept down by pasturage or tillage, meadow-mice are rare or lacking. Thorough cultivation and frequent rotation of crops will prevent these animals from becoming a pest.

As is the case with all the small mammals, climatic conditions have a great influence, directly and indirectly, on the abundance of these mice. It has been observed that, in general, open winters followed by wet summers are most favorable for their increase. If an abundance of grain or other food is present also, marked increase in their numbers is sure to be noticed. Such conditions increase the number of litters and the number in a litter, and probably shorten the time required for attaining maturity.

The enemies of meadow-mice include practically all the carnivorous mammals, the birds of prey, and the majority of our snakes. Among the mammals of this county, weasels and skunks are the most important agents in the repression of these mice and other small rodents. Weasels especially, being fairly abundant, destroy large numbers of mice, and thus probably repay in the fields what they cost in the poultry-yard. Hawks and owls are also great destroyers of field-mice of all kinds. This species, not being strictly nocturnal, more often falls a prey to the hawks than do some of the other species. To the nurseryman or gardener a nest of hawks or owls in the vicinity is worth many dollars. Other birds also, as herons, crows, cuckoos, shrikes, and bitterns, destroy these mice.

If only a limited area is to be cleared of meadow-mice they may be trapped. The small, single spring traps used for house-mice are the most satisfactory. They may be baited with oatmeal and placed near the runs. Some are successful with an unbaited trap put across the runway. Over a larger area they may be cleared out by poisoning. The poisoned bait is prepared as described in the note following this paper. It should be so placed that neither birds nor domestic animals may get it. It is best to place it in the vicinity of their nests under boards slightly raised, or in pieces of small-sized tiling, old cans, or the like. One must bear in mind, however, that in using poison one always runs some risk of doing damage.

In the case of this species it is probably always easier, by thorough tillage, to prevent its becoming a pest than to destroy it after it has become abundant.

MOLE MEADOW-MOUSE; MOLE-LIKE VOLE.

Microtus pinetorum scalopsoides (Audubon and Bachman).

Arvicola scalopsoides Aud. and Bachm., Proc. Acad. Nat. Sci. Phil., I., 1841, p. 97.

I have never identified an individual of this species among our specimens, and I doubt if it is found in this county. Kennicott reports it as common in the northern part of the state. He says that it is readily distinguished from the other meadow-mice "by its smaller size, glossy fur, large muzzle, small eyes, and very short tail." In technical works the distinction is based on the number of mammæ and the form of the teeth. The mammæ in this species are four in number, while there are eight in the other species of *Microtus* found in the state. In this species (Fig. 3), the enamel pattern of the third molar forms two triangles, while in the other species it forms three (Fig. 1 and 2).

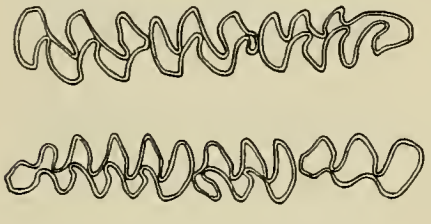

Fig. 3. Molar enamel pattern of mole meadow-mouse. (Bailey.)

This meadow-mouse inhabits woods rather than open fields, and was called the wood meadow-mouse by Kennicott. Otherwise, so far as known, its habits are in general similar to those of the other meadow-mice.

MUSKRAT; MUSQUASH.

Fiber zibethicus (Linnæus).

Castor zibethicus Linn., Syst. Nat., I., 1766, p. 79.

The muskrat, under several subspecies, is found generally throughout North America from northern Mexico to Hudson Bay. The range of the typical form which is found in Illinois is given by Elliot as "Labrador to the Gulf States, excepting possibly the Dismal Swamp, Virginia, and from the Atlantic Coast to the Rocky Mountains north of the Gulf States and Arizona, and south of Keewatin, Canada."

Throughout its range, wherever there is quiet water with abundant aquatic or riparian vegetation, the muskrat is sure to be found unless driven away by persistent persecution. In early days the sloughs that covered a large part of the prairie were the resort of thousands of these animals. Here they found plenty of food and comparative safety from their enemies. As these swampy areas have been drained, the range of the muskrats has become restricted to drainage ditches and the natural watercourses. Although this change in the environment has necessitated a change in habits, the muskrats, with a strange persistence, still remain, and wherever in the till plains or in the sags of the moraines there is still open water enough to wet their feet, traces of their presence may be found. They will not disappear until the drainage is entirely under ground.

In this vicinity the burrows of the muskrat along the banks of streams and ditches open near the level of moderately low water, and extend back some yards into the bank. There are usually openings to the surface also, back some distance from the water. Some of these openings are the work of the muskrats, but many of them are due to the breaking-through of men or animals into the burrows.

When the country was new the muskrat houses were a prominent feature in the landscape, and they may still be seen occasionally. Observers differ greatly in regard to the conditions under which muskrats may or may not build houses. Evidently their habits in this respect differ in different localities. In the lakes and marshes of Wisconsin, Minnesota, and Canada they build houses in two to four feet of water, wherever conditions permit. In this vicinity the houses are found in much shallower water, and in the southern part of its range the muskrat does not build houses at all. This has apparently become a matter of individual variation in this county, for one finds only a small proportion of these animals using houses where, so far as one can see, conditions are equally favorable for all to build them if they wished. These houses serve a double purpose, furnishing both shelter and supplies of food—the interior part consisting of such food plants as are available in the locality. The houses are built solid at first, the interior excavation being made later. While the bottom and interior part are composed of closely packed food-plants, above and on the exterior dirt is mixed with them, and, occasionally, drift materials. Where the water is deep,

the beginning of the house is often made in the form of a raft of edible roots. This raft is added to till its weight sinks it to the bottom. After the solid stack is completed a small cavity is hollowed out in the middle, a little above the water-line, and a runway—sometimes more than one—leading from it is dug down to and under the water. A number of individuals occupy the same house.

The great bulk of the food of the muskrat is vegetable matter—chiefly roots of aquatic and riparian plants. When corn, grain, vegetables, or apples are convenient, the muskrat helps itself to them, and may go a few rods from the water to visit a field or storehouse containing them. At times muskrats feed extensively on fresh-water mussels*. Observations indicate that the more delicate species are taken out on the bank and opened at once with the teeth, while the heavier and stouter species are not opened till they are weakened by lying there. That muskrats eat dead or living fish at times is vouched for by a number of good observers†.

From three or four to at least as many as nine young are produced in a litter. The northern trappers believe that the female produces two broods the first year and three for several years after. The young are hairless and quite helpless when born.

Considerable damage is done by muskrats in fields of corn and grain, though it is seldom serious in any particular locality. Wherever a corn field touches the banks of a stream or ditch, muskrat trails running from the water into the edge of the crop are common. Growing corn is usually cleared off systematically over a small area and carried to the water and eaten. Comparatively little is wasted, stalk and all being eaten. Grain fields in proximity to water are also entered and the grain is cut down, the heads being either eaten on the spot or carried to the edge of the field or into the water. Grain is also carried off after it is harvested and in the shock. Muskrats also damage root-crops when these are grown near their resorts.

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* I am indebted to Mr. James Zetek, of the State Laboratory, for the identification of the following species which had been opened by muskrats on a sand-bar of the Sangamon River, near White Heath. The pile of empty shells included 7 shells of *Symphynota*, 41 of *Quadrula undulata*, 4 of *Q. pustulosa* and 1 of *Q. coccinea*, 7 of *Lampsilis luteolus* and 1 of *L. ventricosus*, 3 of *Tritogonia tuberculata*, 3 of *Alasmodonta complanata*, and 1 of *Anodonta grandis*.

†Bull. U. S. Fish Comm., Vol. IV., pp. 297–298.

Great injury to dams, or other walls of earth used for confining water, may result from the burrowing of muskrats, since their excavations are the beginnings of breaks that may become extensive and entail enormous loss. In this part of the state the loss is chiefly restricted to the banks and immediate vicinity of watercourses. The burrows run back for a considerable distance, and, being near the surface of the ground, cause the banks to cave in and obstruct the stream. Horses and cattle also break through into the burrows, making holes that are both unsightly and dangerous.

In spite of the fact that muskrats are both prolific and locally abundant, they can hardly be regarded as a serious pest. They are easily trapped, and it is seldom that they occasion more loss in a locality than their hides are worth. Traps may be set in the entrance of their burrows or where their runways enter the water; or they may be set near their feeding grounds and baited with a bit of parsnip, carrot, or sweet apple. The bait should be supported over the trap on a stick. If possible the trap should be so placed that the animal may get into deep water when captured; otherwise it is very apt to amputate the limb that is caught and escape.

The skins of muskrats form an important item of the fur trade. From three to four million skins are used yearly, and three fourths of these are from the United States. Their price has varied considerably. At one time they sold for as much as fifty cents apiece, and then were worth more than mink skins.

COOPER'S LEMMING; COOPER'S LEMMING-VOLE.

Synaptomys cooperi Baird.

(N. Am. Mamm., 1857, p. 558.)

The range of this species is from eastern Massachusetts to Minnesota, and south to North Carolina, Tennessee, Indiana, and Iowa.

In color and form this lemming resembles a meadow-mouse, but it is easily recognized at once by the grooves along the front of the broad incisors. It is really a form connecting the meadow-mice, or voles, and the true lemmings; the name "lemming-vole" is therefore the most appropriate one, though too awkward for common use.

Everywhere within its range this species seems to be the rarest of the small mammals—or, at least, the one most seldom trapped. The only two specimens in our collection were found together in the

vicinity of Urbana. They were both dead, and the head of one had been eaten off. Persistent trapping in the same vicinity failed to give us any others. Collectors throughout all its range agree in regard to its remarkable scarcity. The only place where it seems to have been even moderately abundant is in the vicinity of Brookville, Indiana, and about the only observations we have on its habits were made by Quick and Butler* at that place. They found it most numerous on hillsides in high, dry blue-grass pastures, where stones are irregularly scattered over the surface. Our specimens were found on a low bluff overlooking a creek, in pasture-land where there were stumps and scattered trees. However, the dead animals may have been merely brought there. Other collectors have taken them from swamps—wet or dried-up—and from spruce woods, *Sphagnum* bogs, etc.

Quick and Butler say that these animals breed from February to December, and that the nests, made of soft dry grass, are always under cover, often in hollow logs or stumps.

The food of Cooper's lemming is entirely vegetable so far as known, consisting of stems and roots of grass and other plants. The form of its incisors would seem to prevent it from eating nuts or hard-shelled seeds. It stores up various kinds of roots for winter.

Its numbers are said to vary greatly at Brookville from year to year.

POCKET-GOPHER.

Geomys bursarius (Shaw).

Mus bursarius Shaw, Trans. Linn. Soc., V., 1800, pp. 227–228, Pl. 8.

This animal derives its name from the pockets in its cheeks. They are lined with fur and open on the outside. Its total length is about 10.85 in. (275 mm.). The tail is 3.34 in. (85 mm.) long. The color is nearly chestnut above and below, but paler on the belly. The feet are whitish.

The pocket-gopher is found in the prairie region of Illinois, in the southern half of Wisconsin, in Minnesota very nearly up to the Canadian border, in the eastern part of the Dakotas and Nebraska, and in northeastern Kansas and Missouri. It is strictly an inhabitant of the prairie throughout this range.

* Am. Naturalist, Vol. XIX., pp. 113, 114, 115, 116, 118.

We have no specimens from this county, nor have I actual proof of its being found here. Several times the presence of its burrows in the county has been reported, but each time investigation has shown that the burrows observed were the work of moles. I have taken it in Mason county, and it is reported to be common in the western part of the state.

This animal leads a life so largely subterranean and nocturnal that it is seldom seen. We have taken specimens within a few rods of the house of a farmer who had never seen the animal before though he had lived in that locality over twenty-five years. Its presence is plainly indicated, however, by small mounds of earth thrown up from its burrows. These mounds usually vary in diameter from a few inches to two feet, and are eight or ten inches high. On the prairies in the West, or wherever they are undisturbed for a long time, they may be of much larger dimensions. No opening is evident in these mounds, the earth of which they are composed being pushed out ahead of the animal, and the last load left to block the entrance. The extensive burrows are from one to two feet below the surface, and their general location is indicated by the dirt-piles, and never by ridges on the surface as are those of moles. They also differ from mole-runs in being deeper and larger, and in the fact that the dirt from them is brought to the surface—not simply pushed aside, as is so often done by the mole. In digging its burrow, this gopher pulls the earth back under it with its fore feet, then kicks it still farther back with its hind feet, and finally, when a considerable quantity has accumulated, it turns in its burrow, brings its fore feet together with the palms vertical and at right angles to the body, and with its hind legs pushes itself and the dirt out of the burrow. Merriam says that it can run as fast backward as forward, and that in carrying food it usually does so, reminding one of the motion of a shuttle.

Very rarely solitary specimens are seen above ground, evidently prospecting for a change of locality. They apparently live in solitude except for a short time while mating. The eyes are small and the animals appear intolerant of bright light, carefully closing all openings into their burrows. They are extremely silent creatures, the only noise they ordinarily make being a hiss that appears to be merely a forcible inspiration and expiration of air. Under rare circumstances they utter a feeble squeak. It is doubtful if the sense

of hearing plays any very important part in their life. Merriam suggests that the naked tail may serve as an organ of touch to guide the animal when running backward through its burrow.

The food of this gopher consists largely of such vegetable matter as can be obtained under ground, that is, roots, tubers, and rhizomes of various plants. They use practically everything of this kind that they meet with. Even trees so large as six inches in diameter have the roots cut off and eaten by them. They also come out of their burrows at night under cover of vegetation and eat and carry away seeds and vegetative parts of plants. These are stored in their pouches and carried to underground storehouses connected with their runways.

The pocket-gopher is not known to hibernate. Where the ground does not freeze severely it may continue burrowing all winter, storing the dirt from its excavations under the snow.

Pocket-gophers are not fertile when compared with most other mammals, and their abundance in certain localities is due rather to their ability to escape their enemies than to their fertility. Available data indicate that while two to six may be produced in a litter the average number is about three, and that there is but one litter a year. The young are born in spring, about the end of April. By the middle of June they may be half grown and starting their own burrows.

As these gophers appear so rarely above ground, they suffer comparatively little from natural enemies. A few are killed by hawks, still more are caught by owls, and probably all the larger *Carnivora* sometimes surprise and capture them; but once safe in their burrows, even the fox and the badger can not easily get them. Probably their chief enemies in this state are the weasel and some species of snakes. The former is able to follow the gopher into its burrow and kill it, and it is known that some of the larger snakes do the same.

In this part of the state, pocket-gophers are too rare to be of any importance economically, but in other sections of the country they are often a serious pest. In nurseries and forest plantations they do great damage by gnawing off the roots of small trees. When they attack a tree their habit is to gnaw off all the roots at the base, thus leaving the tree without any means of support. Trees of considerable size are destroyed in this way. These gophers do great damage to root-crops also, potatoes being sometimes so badly in-

jured that those remaining are not worth harvesting. Grain, either from the standing crop or from the shock, is likewise taken down into their burrows.

The piles of earth thrown up from their runways disfigure the fields, cover the crops more or less, and are in the way of the harvester or mowing-machine.

It has been urged in favor of the pocket-gopher that it benefits the soil by working it over; by burying vegetable matter, which decays and increases fertility; and by bringing the deeper layers of the soil under the influence of the atmosphere. However this may be, when the gopher prosecutes this system of cultivation in the midst of a meadow or an alfalfa field his efforts are not appreciated, and he must go.

There are but few pests more easily gotten rid of. The simplest and safest way under ordinary circumstances is to trap them. The most satisfactory trap is the ordinary No. 0 steel one. To set it, dig down to the burrow, choosing a place one or two feet from a recently cast-up dirt pile. Be careful to remove all dirt dropped into the runway. Excavate a slight hollow and set the trap so that it will be nearly on a level with the bottom of the run, and sprinkle it over with fine dirt, nearly covering it. Cover the opening loosely with a bit of board or sod, not excluding quite all the light.

This gopher may be poisoned by introducing poisoned grain (see final note) into the burrow through a small hole. The use of poison always involves some risk, but it can seldom be more safely used than for the pocket-gopher.

JUMPING MOUSE; HUDSON BAY JUMPING MOUSE.

Zapus hudsonius (Zimmermann).

Dipus hudsonius Zimm., Geogr. Gesch. d. Menschen u. vierfüss Thiere, II., 1780, p. 35.

This is a northern species, ranging from the southern shores of Hudson Bay south to New Jersey and, in the mountains, to North Carolina, west to Iowa and Missouri, and northwest to Alaska.

It seems to be nowhere abundant. Kennicott reported it from the northern part of the state, but we have no Illinois specimens. It may be recognized by its long hind legs and its long jumps when escaping pursuit. Its color somewhat resembles that of the white-

footed wood-mouse, but is rather more ochraceous over the upper parts. Its habits, also, so far as known, resemble the habits of that species. It was found hibernating, however, by Hoy.

It is extremely desirable that specimens of the species found in the state should be reported. It is apparently much rarer here than formerly, and may be on the verge of extinction.

SWAMP-RABBIT; SWAMP-HARE.

Sylvilagus aquaticus Bachman.

(Journ. Acad. Nat. Sci. Phil., 1837, p. 319.)

This species is found in the cypress swamps in the southern part of the state as far north as Cape Girardeau, Mo. Its range south extends to the Gulf.

It is much larger than the common rabbit. A specimen taken December 28 near Olive Branch, Alexander county, gave the following measurements: Length, 19.8 in. (503 mm.); tail, 2.17 in. (55 mm.); hind foot, 4.33 in. (110 mm.); ear, 3.7 in. (94 mm.).

The general color scheme is similar to that of the cottontail. The cheeks, sides of head, and the nape are gray; the sides of the body are gray with a faint wash of ochraceous; and the top of the head and the back are pale ochraceous much mottled with a rich black. There is a well-defined spot of rusty cinnamon on the shoulder, and the upper part of the feet is tawny ochraceous. The under parts are pure white but for an ill-defined color of faint ocher under the throat.

This species keeps to the deep swamps in this state. It swims readily, and when pursued takes to the water, and may even dive to escape. It is said that even on dry land it rests on logs or stones rather than in forms. Evidently this is a habit that has grown out of its living in swamps.

Young are produced at least twice a year, and in litters of four to six.

COMMON RABBIT; COTTONTAIL.

Sylvilagus floridanus mearnsi (Allen).

Lepus sylvaticus mearnsi Allen, Bull. Am. Mus. Nat. Hist. N. Y., 1894, p. 171.

E. W. Nelson, in his recent monograph of the Rabbits of North America (N. Am. Fauna, No. 29) refers the rabbits of this section to

this form. The range as given by that author is as follows: "West of Alleghany Mountains from Lake Simcoe, Toronto, Canada, central New York, central Pennsylvania, western West Virginia, and eastern Kentucky, and eastern Tennessee, west through southern Michigan and Wisconsin to southeastern Minnesota, and south through Iowa to Trego county, Kansas, northern Missouri and Illinois, with all of Indiana and Ohio."

The following description is based on the examination of forty-seven specimens, all shot December 5, 1908, in the same locality. The records of all the specimens shot of which a complete record could be given are included. Probably a good proportion of the specimens were born that season.

The average measurements are given below.

No. of specimens measured	Average length									
	Total		Tail		Head and body		Hind foot		Ear	
	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
25 females	16.72	424.2	1.66	42.2	15.06	382.	3.86	97.9	2.7	68.6
22 males	16.52	419.9	1.66	42.2	14.86	377.6	3.89	98.8	2.74	69.6
Average for the 47	16.60	422.2	1.66	42.2	14.94	380.	3.86	98 1	2.72	69.

The accompanying polygon of lengths of body and head shows better than the above the range in size.

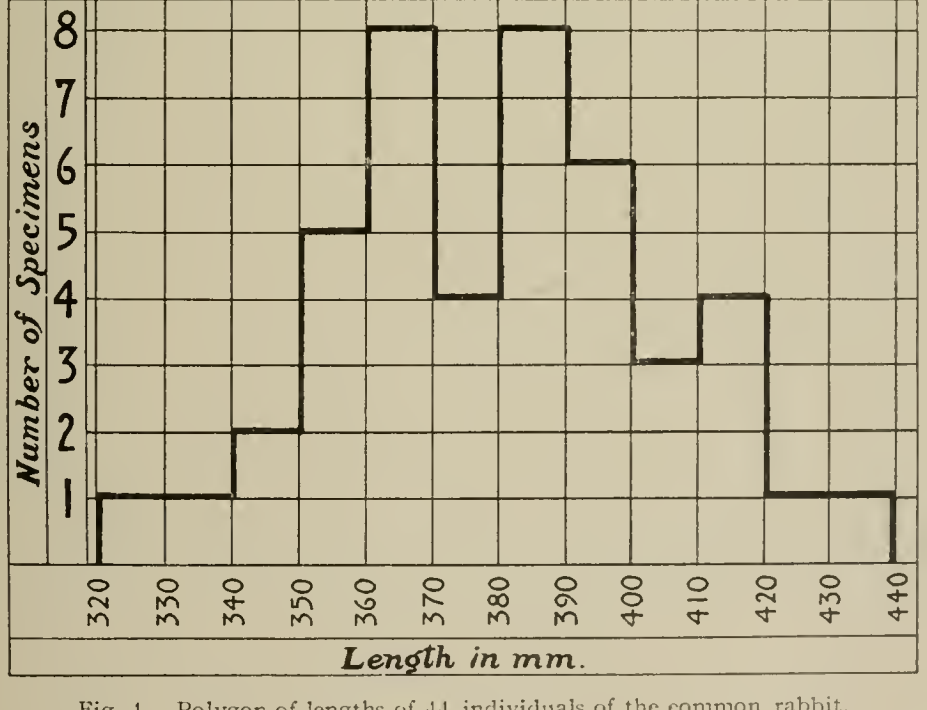

Fig. 4. Polygon of lengths of 44 individuals of the common rabbit.

The hair is everywhere plumbeous at base, and the following description applies only to the outer portion of the hairs.

On the chin, on the lower edge of the upper lip, on the belly and breast, and on the *most* of the inside of the thighs and on the under side of the tail the hair is white. On the upper parts in general, the finer, shorter hairs are tipped with a pale chestnut. The longer hairs usually have a band of black followed by one of cinnamon, and, finally, a black tip (often lacking), the general effect produced being a mottled black and cinnamon. This is characteristic of the top of the head, the side of the shoulders, and the back. On side of head, cheek, and over rump and upper part of outside of thigh the cinnamon band is lacking, being replaced by a soiled creamy white, and the general color is gray. The hairs on the nape, and backward over the shoulder are cinnamon-color, varying to vinous cinnamon. The outside of the front leg, a spot just in front of the groin, and the back part of the thigh are also cinnamon. From the spot in front of the groin an ill-defined band of pale vinaceous cinnamon extends along inside of the thigh to the heel. The front edge and tip of the ears outside are black, the rest being cinnamon-gray. The inside of the ear is white at the tip. The margin is also white except the lower outer portion, which is gray. Above the eye is a grayish spot. In some specimens the neck is encircled by a broad grayish cinnamon collar, which is quite clearly defined, especially below, by the white of the breast.

The chief variations from the description are as follows: (1) The collar just mentioned may be very obscure. (2) In about half of the specimens there is a trace of a white spot between the eyes, and this, when present, may be quite conspicuous, or it may be represented by half a dozen white hairs. (3) The inside of the thighs is sometimes flushed with buff; and (4) the rump and upper part of tail at the base may be more or less cinnamon.

Estimated by bulk or weight, rabbits undoubtedly represent more mammalian life than any other wild animal in the county, and they are found in every part of it—prairie or wooded bluff or flood-plain. They are now the chief reliance of our sportsmen in the fall, and many hundreds of them are killed within a few miles of Champaign and Urbana. Their persistence in spite of furious persecution is really remarkable. They are found within these city limits at all times of the year, but appear especially abundant in the

early winter after the first falls of snow. On mornings following a snow storm in early winter the hunters are especially numerous in the country, and even in the vicinity of these cities one may hear an almost continuous fusillade. At such times the rabbits appear to come in through the "firing line," and take refuge in the cities. Fortunately they are not hunted to any great extent except during a few weeks in the year, and the larger carnivores and birds of prey which are their natural enemies are nearly extinct in the county.

While rabbits are perhaps more abundant in the vicinity of groves or the edges of woods, they are found wherever there is sufficient vegetation to conceal them. On the prairie, during the spring, before vegetation appears, they are hard pressed for shelter, but hedges, the waste ground along fences, ditches, and roads serve, with their unremitting vigilance, to tide them over till the new growth furnishes them abundant cover. Later, they are found in the corn fields, where they often remain all winter, making nests under some exceptionally large clod or under fallen stalks of corn. After a heavy snowfall they are easily taken in these places, being loth to leave them, and appearing stiff and stupid when driven out. They also winter in the woods, and probably the larger number of those in the vicinity of timber take to brush-heaps, thickets, etc., for shelter during the winter. Many, however, are true inhabitants of the prairie, remaining there the whole winter through.

In general the rabbit is decidedly non-resistant, but at times, the mother may defend her young by kicking with her hind feet, and a blow from a rabbit's foot, with its heavy nails, is not to be despised. But fighting is always a last resort with rabbits, and flight is their usual recourse for safety, and all the peculiar adaptations of the animal seem made to that end. Their senses of hearing and of sight are remarkably acute, and the flexibility of the ears and the position of the eyes make it possible to use both through a wide angle. It would seem that the sense of smell is also acute, though not so much relied on. Though the necessities of their existence in a well-cultivated district like this, demand that rabbits be constantly alert, they are essentially crepuscular or nocturnal, feeding chiefly from sunset to sunrise.

Under natural conditions, their food, so far as known, is entirely vegetable. In confinement the female may eat her young, and the male is given to destroying them. It is probable, however, that

this occurs but rarely in nature. While grain and roots may be eagerly eaten by these animals when they can be had, ordinarily by far the larger part of the food is the vegetative part of plants, including leaves, stems, twigs, and bark. Of these a wide variety is used. Much of their food is furnished by plants not useful to man.

The rabbit is proverbially prolific, though not more so than many other rodents. There are usually four to six in a litter, and in this latitude probably at least three litters a year. Rabbits are polygamous. The young are born in shallow nests lined with grass, on which the mother lays hair from her own body. She occupies a separate nest near her young. They become mature at an early age, and may bear young—possibly two litters—before they are a year old.

Rabbits destroy small quantities of small grain, corn, and vegetables, but this loss within the county can not be very considerable. Possibly their chief injury here is done by barking and gnawing young trees. In other localities at least, this loss becomes a serious matter to the nurseryman and fruit-grower, though it is not apt to occur except where considerable snowfalls cover other sources of food. This has not often happened with us in recent years, and as fruit-growing is a very subordinate business in this county I doubt if the damage to fruit-trees by rabbits amounts to very much.

As they furnish about the only game throughout most of the county, hunters are well able and more than willing to keep them in check *gratis*. If they were to be entirely protected for a few years over any considerable territory there is no doubt that they would become a pest.

AMERICAN RABBIT; VARYING HARE; WHITE RABBIT.

Lepus americanus Erxleben.

(Syst. Regn. Anim., I., 1777, p. 330.)

According to Kennicott,* several individuals of this species were shot on the present site of Chicago in the winter of 1824. It is probably extinct in the state at present.

The species is much larger than the common cottontail, and its fur turns white in winter.

It is a northern species, its range extending nearly to the Arctic Ocean.

* Rep. Comm. Patents, 1857, p. 84.

FLESH-EATING ANIMALS.

CARNIVORA.

PANTHER; PUMA.

Felis concolor Linnæus.

(Mantissa, 1771, p. 522.)

Kennicott reports a single individual in Cook county. Individuals must often have followed up the larger rivers in the state in early times. Among the earliest settlers of this county I find a general impression that panthers were sometimes seen here, but I have been unable to obtain any definite data.

CANADA LYNX.

Felis canadensis (Kerr).

Lynx canadensis Kerr, Anim. Kingd., 1792, pp. 32, 157.

This species is listed by Kennicott as found in Cook county, and two species of lynx, or wildcat, are recorded as being in the state by various early writers. Owing to the common confusion of the two species it is perhaps impossible to tell now to what extent, if at all, this species was present within the state. It is not likely that it was ever seen by a white man within this county.

WILDCAT.

Felis ruffa Güldenstaedt.

(Nov. Comm. Acad. Imp. Sci. St. Petersburg, XX., 1776, p. 484.)

Wildcats were formerly found throughout the state wherever there was extensive heavy timber, and they are still not uncommon in the heavily wooded portions in the south. I obtained the skull of a specimen at Olive Branch, Alexander county, in 1908. A number of them had been killed in that vicinity. Merriam says that in the Adirondacks they nest in hollow trees, making a soft bed of moss. From two to four young are produced in a litter. In thinly settled sections the wildcat often destroys the farmer's lambs, small pigs, and poultry. Their regular food in a wild state consists of rabbits, squirrels, and other small mammals, together

with such birds as they can get. The early settlers of the county declare that wildcats were found in the county between 1835 and 1840, but I can get no proof of their being found later.

TIMBER-WOLF.

Canis occidentalis (Richardson).

Canis lupus occidentalis Richard., Fauna Bor. Amer., Mamm., I., 1829, p. 60.

The timber-wolf ranged originally over all the timbered portions of the United States and the adjoining portions of Mexico and Canada. Whether all the forms found in this territory should be classified as belonging to one or more species has not been well settled. They were formerly abundant along the wooded bluffs and the forest areas everywhere throughout Illinois, and are still found in the state occasionally in various localities.

The species varies so greatly in both size and color that no exact description of it can be given. Judging from the scanty material available, perhaps the average specimens met with in this state might be described as follows:

Length, 4 feet (1220 mm.); tail, 15 inches (380 mm.).

Young pups with soft woolly hair, buff to ochraceous in color, lighter below. Ears tipped with tawny ochraceous bordered with black.

General color of adult gray, with more or less ochraceous. Color lighter below, the feet sometimes becoming nearly white.

In the wilderness wolves live chiefly on rabbits and deer. The number of deer killed by them is enormous. In more civilized sections of the country they take up with whatever animals they can catch and kill. Their liking for sheep is proverbial, and a bounty on wolf scalps is still offered in most parts of the state. During the years 1883 to 1905 inclusive, bounties were paid on 159 wolves killed in Champaign county. Wolves have been reported within the county since that date, and it is not at all unlikely that a few still exist in the heavy timber along the Sangamon River and the Vermilion.

They den in such shelter as is furnished by caves, upturned trees, etc. There are six to ten pups in a litter. Judging from the list of bounties paid in this county, the number in a litter here is from four to nine.

PRAIRIE-WOLF; COYOTE.

Canis latrans Say.

(Long's Exped. Rocky Mts., I., 1823, p. 168.)

Prairie-wolves were formerly abundant throughout the prairie and plains region of the United States and Canada to the Saskatchewan. A wolf reported to be of this species was killed in Winnebago county, Illinois, during the winter of 1908–09, but we have not been able to verify the identification. The early settlers declare that prairie-wolves were still common in this county about 1850, and that they were seen ten years later.

RED FOX.

Vulpes fulva (Desmarest).

Canis fulvus Desm., Mamm., I., 1820, p. 203.

The red fox is found from the Canadian boundary south to Georgia and west to the great plains.

This fox is too well known to need description. It is one of the few medium-sized mammals that by their adaptability and cunning manage to exist in a well-settled country. Twenty or thirty years ago it was very abundant in this county, and is now by no means rare. It is an inhabitant of the bluffs, though it makes excursions for some distances into the adjoining country.

Foxes prey on every living thing that they can catch and overcome. They do not disdain carrion, and when hard pressed by hunger have been known to turn vegetarians and eat apples, grapes, and strawberries.

They produce four to nine pups in a litter, rather early in spring.

In a wild and rough country foxes make their dens at times in caves, under ledges of rock, and even in hollow stumps and logs. In this vicinity they are probably always in burrows.

When captured young, the red fox is easily tamed and makes an interesting pet. It is exceedingly playful, and comes to enjoy human society, but unless much and wisely handled is apt to become treacherous as it gets older. A young fox in captivity at Mahomet, in this county, enjoys being taken to the fields and allowed to hunt grasshoppers, and is quite clever in catching them.

Except by destroying game, foxes do very little damage in the county at present. Poultry-yards are so well guarded and easily accessible food so abundant that foxes are not tempted to make a raid on the farmers' hens. On the other hand, they destroy mice and moles, and thus make some compensation for the game they kill.

GRAY FOX.

Urocyon cinereoargenteus (Müller).

Canis cinereoargenteus Müll., Natur. Suppl., 1776, p. 29.

The gray foxes, including several subspecies, are found in timbered regions in all parts of the United States and Mexico. The type species occurs from Georgia north to New England and west through the timbered portions of the Mississippi Valley.

The gray fox is about the size of the red fox. The general color of the upper parts is a mixture of gray and black. The outside and base of the ears, the side of the neck, the edges of the belly, and more or less of the outer side of the limbs are ochraceous to cinnamon-brown. There is a band of black across the muzzle. The lower half of the head, chin, and sides of muzzle are white. The under parts are ferruginous.

The gray fox was originally fairly abundant in this county, but is now quite rare. Its general scarcity as compared with the red fox is probably due to a difference in habit. It is not a burrowing animal, and is more dependent than the red fox on heavy timber and an unsettled country for dens and shelter. It is therefore far more intolerant of civilization than the red fox, and is replaced by that species as the country becomes thickly settled.

BLACK BEAR.

Ursus americanus Pallas.

(Spicileg. Zool., Fasc. XIV., 1780, p. 5.)

The black bear is found in the eastern part of North America wherever forests are found, except in Labrador, Florida, and Louisiana. Closely related species continue the range to the Pacific and south to Texas.

I have not been able to find any one among the early settlers who could vouch for a bear's being seen in the county. They were com-

mon in the river bottoms in the southern part of the state, and it is more than likely that they sometimes followed up the rivers to the borders of this county. They are probably extinct now in Illinois.

RACCOON; COON.

Procyon lotor (Linnæus).

Ursus lotor Linn., Syst. Nat., I., 1758, p. 48.

The common raccoon, under various forms, is found throughout the United States and Mexico, and north into southern Canada. It occurs throughout Illinois, and is not rare in this county.

Raccoons haunt wooded bluffs and the timbered flood-plains, and are seldom found far from them. They may make raids into corn fields and chicken-houses at some distance during the night, but they spend the daytime in some big hollow tree in the woods, and when pursued always seek shelter in a tree. They have been known in severe winter weather to live around haystacks and outhouses, but this is very unusual.

The raccoon is an omnivorous carnivore, as the rat is an omnivorous rodent, and its food, like the rat's, varies with the time and place, being largely a matter of what it can get. It is fond of berries and other fruits, and will eat most garden vegetables, though it prefers those that have a sweetish flavor. Its liking for young corn is well known. It eats crayfish, and has been accused of catching minnows and trout. It is exceedingly fond of eggs, as well as of birds and poultry, if it can get them. It also eats, with apparent relish, grubs and various insects which it picks out of holes and crevices, and it is said to kill and eat small mammals at times. The specific name *lotor*—meaning washer—was applied to the coon because of its well-known habit of washing its food before eating it. The instinct is a curious one, and I know of no satisfactory explanation of it. The animal is very fond of paddling in the water, and a pair of tame raccoons kept by Godman would indulge in this sport even in the coldest weather, when the ice had to be broken in order to let them get to the water.

In this latitude the raccoon breeds in March or April, but the breeding season is a month later in the Northwest Territories of Canada. The usual litter contains from four to seven young.

In the extreme northern part of its range the raccoon hibernates during the most severe weather, but in this latitude, though less active and disposed to take long naps during the cold weather, it is doubtful if it ever falls into a profound winter sleep. In captivity it shows a remarkable indifference to cold or inclement weather.

As a pet, none of our mammals is a greater favorite. Though it is always mischievous and destructive if opportunity occurs, its interesting and affectionate ways keep it in favor.

Raccoons do a certain unknown amount of good by destroying insects injurious to forest-trees. They also destroy crayfish and small mammals, and possibly in that way benefit man at times. The mischief they do in corn fields, in chicken roosts, and to useful birds is well known. Whether the balance is in favor of or against the coon depends on circumstances; but, in any case, in a portion of the state so poorly provided with objects of sport as this the raccoon merits more sympathy and protection than it receives.

BADGER.

Taxidea taxus (Schreber).

Ursus taxus Schreb., Säugth., III., 1778, p. 520.

Kennicott, in his list of the mammals of Cook county, published in 1854, says the badger was formerly common in that county, and was still so farther south. It is reported that a specimen was killed a few miles north of Urbana in 1908. The dead animal was seen by reliable persons, but I have not been able to verify the identification by seeing its skin. The badger undoubtedly occurs in the northern part of the state, though I have no reliable record of one's being found recently.

SKUNK.

Mephitis mesomelas avia (Bangs).

Mephitis avia Bangs, Proc. Biol. Soc. Wash., XII., 1898, p. 32.

The skunks of this locality are referred to the above subspecies, the type of which came from San Jose, Mason county, Illinois. There is considerable variation in size, color, etc. The description given by the author of the subspecies is as follows: "Black all over except white frontal stripe, nuchal patch, and two lateral stripes

extending back from nuchal patch. Tail very short and bushy, black externally, most of the hairs white at base. Total length 607–675 mm. [24–26.5 in.]. Tail vertebræ, 177–190 mm. [7–7.5 in.]. Hind foot, 65 mm. [2.56 in.]."

Skunks are found in all situations in the county, being most common about the pastures and bluffs, but are nowhere very abundant. As they are the least shy of all our larger mammals and make their presence known in a variety of ways, they are not apt to be overlooked in any locality.

Skunks walk on the soles of the feet, with the body somewhat arched and the tail more or less elevated. When disturbed they erect the long hair on the back and tail, displaying to the fullest the contrasting black and white as a warning. The tail is waved vigorously, giving rise to the impression that the offensive liquid which the animal secretes is flung on its enemies by that means. As a matter of fact, it is ejected in slender jets from glands near the anus. The secretion is a straw-colored fluid lighter than water, containing a number of organic substances called mercaptans. Inhaled in large quantities, the vapor acts as an anæsthetic, producing unconsciousness, heavy breathing, and coldness of extremities. It would undoubtedly prove fatal if inhaled too long.

This secretion seems to be an extreme development of what is common to other animals, especially minks and weasels, which are the skunk's nearest relatives. What in them is probably a secondary sexual character, by which the sexes detect or allure each other, has become in the skunk, by further development, its most potent defense, on which it depends almost entirely for its safety. It is clumsy in its movements, can neither climb nor swim well, and yet no other mammal in the state is so independent and shows such indifference to its enemies.

The dens of skunks are chiefly burrows, but it is said that nests are sometimes made by these animals in stumps, hollow trees, etc. They occasionally take refuge under barns or even beneath houses. They are said to be gregarious, a large number—not all of the same family—being found in one den. They are chiefly nocturnal in their habits, though their indifference to danger allows them to remain abroad till daylight.

Skunks probably make use of all kinds of animal food that they can get. They are preeminently insect eaters, destroying enor-

mous numbers of the largest insects, both adult and larval. They catch frogs, salamanders, mice, and other small mammals, and they eat the eggs and nestlings of such birds as nest low, sometimes, no doubt, getting the birds themselves. Unfortunately for its reputation the skunk does not hesitate to take the farmer's eggs and poultry when they come in its way, and when once it discovers where they may be found it shows considerable persistence and cunning in getting them. Eggs are eaten on the spot. Fowls are killed by a bite on the neck, and are usually carried away.

The young, six to ten in number, are produced in spring.

The skunk does not hibernate except in very severe weather—probably not at all in this locality.

Under present conditions in the county, there is probably no mammal more unjustly persecuted than the skunk. Its offensive odor is only used in self-defense, and it is easy to guard against its raids on poultry-yards. A less defensible damage is that caused by its destruction of the eggs and nestlings of ground-nesting birds; but whatever damage may be done in this way is undoubtedly more than compensated by its destruction of enormous quantities of grubs, grasshoppers, large beetles, etc., and by the large numbers of mice and voles which it destroys. Merriam says on this subject: "I do not hesitate to assert that a single skunk nets the farmer more in dollars and cents each year than he loses from their depredations during his entire lifetime."

The skin of the skunk forms an important article of the fur trade, its value depending largely on the color, as well as on its size and condition. In general, the more nearly black a skin is, the more valuable it is.

The flesh of the skunk is said to be white and tender and of delicious flavor. It is needless to say that the scent-glands should be carefully removed before cooking.

Those who have had the temerity to try it, assert that the skunk, if taken young, makes an inoffensive and delightful pet, becoming gentle and playful, and showing no inclination to use its battery.

Skunks are easily trapped, their self-confidence making them exceedingly careless.

AMERICAN MARTEN; HUDSON BAY SABLE.

Mustela americana Turton.

Mustela americanus Turton, Linn. Syst. Nat., I., 1806, p. 60.
Mustela martes, Auct.

Recorded by Kennicott from Cook county, Illinois. Long extinct within the state. No record of its occurrence in this county.

FISHER.

Mustela canadensis Schreber.

(Säugth., III., Text, p. 492, 1777, Pl. CXXIV., 1776.)

Kennicott says that "the fisher used frequently to be seen in the heavy timber along Lake Michigan." It is now extinct throughout the state so far as known. There is no positive proof that it was ever taken in this county.

MINK.

Putorius vison (Schreber).

Mustela vison Schreb., Säugth., III., 1777, p. 463.

The mink is found, under suitable conditions, throughout the United States and British America to Hudson Bay and northern Alaska.

The length of the common mink is from 15 to 18 inches (381 mm. –450 mm.), and the length of the tail is 6 to 8 inches (152 mm.–203 mm.).

Its color varies from a dull yellowish-brown—near russet of Ridgway—to a deep chocolate or seal-brown, but slightly, if at all, paler below. The tail is darker—blackish. The chin, and usually a patch on the breast and several spots between the fore legs are white. The tip of the tail also is sometimes white.

Though never abundant in this state, the mink is found along all our watercourses. Next to the otter it is the most expert in aquatic life of any of our mammals. Nevertheless, it is sometimes found quite remote from any water, and readily makes its way over long distances when streams or ponds are frozen or dried up. A goodly number are taken in this county each winter, many of them being caught in the mouths of tile-drains along drainage ditches in the open country. Wherever there is a farmhouse near a stream

there is pretty sure to be complaints of loss of poultry by minks. In some cases the trespasser has been caught in the act, but probably a weasel or a rat is sometimes the true culprit.

The mink swims swiftly, with the whole body, except the nose, submerged, and dives so skillfully that it can follow and catch trout and other active fish. While not an expert climber, it can ascend surfaces that furnish a nail-hold, but its active life on land is spent chiefly near the ground, creeping through brush and weeds, stalking its prey. Observers are not agreed as to whether it digs its own burrow or not. Certainly it sometimes takes possession of a muskrat's hole, ejecting the rightful owner. Minks' nests are also found in hollow logs, under old stumps, and in similar localities. They are made of soft grass or leaves, and lined with feathers and hair.

If circumstances are favorable for the mink in its preferred resorts along streams or other bodies of water, its food will be largely fish, bugs, crayfish, or mussels, with an occasional muskrat; but it is apt to forage also, more or less, in the adjoining territory, catching mice, rats, and rabbits, and stealing birds' eggs. Its reputation for robbing poultry-yards is well known, though the majority of observers agree that, unlike the weasel, the mink seldom kills more than two or three fowls at a time.

The mink produces one litter a year, in April or May. Gestation lasts 6 weeks, and the young are 6 to 10 in number. When born they are hairless, "about the size and shape of a little finger," but in a short time they are covered with a soft, thick, glossy fur. The young follow the mother till fall. The females are said to develop in ten months, while the males require 18 months to reach maturity.

Whether the mink is, on the whole, a benefit or injury to man depends on circumstances. Where mice, voles, rats, and crayfish are abundant, its good offices may predominate; but where these are lacking, and game-fish, game-birds, or poultry are within its reach, the account would surely stand the other way. In either case, so long as its pelt is so valuable there is little danger of the mink's becoming excessively numerous.

Mink fur is short, but thick and very durable, and the skin, though thin, is exceedingly tough. The price of the fur depends on its popularity, and consequently varies greatly from year to year.

Emmons, writing in 1840*, says: "The fur is of little value on account of its shortness, though it is quite fine." Later its beauty and durability began to be appreciated, and the price of mink skins rapidly rose, till, in 1865, skins of prime quality were quoted at $15 each. Since then the price has declined; but to-day the pelt of the mink, in proportion to its size, is more valuable than that of any other aquatic animal except the sea-otter and the best seal.

The mink has often been tamed, and is said to make a gentle and interesting pet, the only drawback being the exceedingly offensive odor which it produces at times.

Minks are often taken in this county in traps set in the opening of tile drains or old muskrat burrows. Traps are sometimes baited for them with bits of meat, small animals, or fish.

WEASEL.

Putorius noveboracensis Emmons.

(Rep. Quadr. Mass., 1840, p. 45.)

Putorius erminea Coues. Fur-Bearing Animals, pp. 109–136 (in part).

This species occurs from Illinois east to the Atlantic, and from North Carolina and Tennessee north into Canada, while closely related species range as far north as the Arctic Ocean. All of these species were formerly included, with the ermine of Europe, under the name *Putorius erminea*.

Male and female weasels differ considerably in size, the average length of the male being 16.5 in. (407 mm.); tail vertebræ, 5.5 in. (140 mm.); and hind foot, 1.85 in. (47 mm.). The corresponding measurements for the female are 12.8 in. (324 mm.), 4.25 in. (108 mm.), and 1.36 in. (34.5 mm.).

In summer, the upper parts, including the feet, are a rich dark chocolate-brown, often near seal-brown. The under parts, as well as the upper lip, are white more or less washed with sulphur-yellow. In winter, in the southern part of its range, the whole animal becomes entirely white except the terminal third of the tail, which is jet-black. In the South the winter pelage is similar to that of summer, but a trifle paler. No white specimens are in our collection, but they have been reported within the county by reliable observers. In the northern part of the state they are common.

* A Report of the Quadrupeds of Massachusetts, p. 44.

The body is slender and cylindrical. The neck is remarkably long, and nearly as large in diameter as the body. The head is small and triangular in shape, the nose being pointed, and the cheeks are swollen with the enormous jaw muscles.

The weasel is probably found under all physiographic conditions represented in the county. My own records indicate its greatest abundance along the border of smaller watercourses in the till plains and the sags of the moraines. This indication of greater abundance, however, may be in part due to the fact that weasels are more conspicuous in such localities. Unlike the mink, they are not aquatic, and are not known to enter water for food. They climb readily, and leap from branch to branch like a squirrel.

All observers of the weasel have been struck with its fearless inquisitiveness and indomitable ferocity. Audubon says that it seems to possess an intuitive propensity to destroy every animal and bird within its reach, even some which are ten times its own size. It is, however, preeminently a mouse-catcher, and house-mice, field-mice, and voles form the bulk of its food in this locality. To these should be added, however, gophers, rabbits, chipmunks, birds' eggs, birds, and poultry—the latter an occasional indulgence. It is a question whether in this county weasels or rats should have the dubious honor of destroying the greater number of young chickens, but as to the destruction of half-grown or full-grown fowls undoubtedly the weasel destroys as many as are destroyed by all other pests together.

The weasel has but one litter a year. In this latitude the young are produced in April or May, the number in a litter varying considerably, from two to twelve having been reported.

The nests are found under such shelter as logs or stumps, and in hollow trees or in burrows. Some observers declare that they use the burrows of animals that they have dislodged, while others imply that they make burrows themselves. Possibly both statements may be true.

It can not be denied that the weasel kills many animals that man would prefer to kill himself. Besides its raids on the poultry roosts, it kills many rabbits, quail, and prairie-chickens. In the northern part of its range a single weasel has been known to kill as many as eleven rabbits during one night's raid. These were all dragged a short distance and buried in the snow. They had all been killed

by a single bite between the eyes and the ears. Whole coveys of quail are often killed by weasels, but the marks of their teeth being very small, may be easily overlooked, and the quail be supposed to have frozen to death. On the other hand, it should be remembered that these raids on useful animals are comparatively rare, while every night in the year the weasel's unceasing slaughter of mice, rats, and other vermin goes on. It is probably a fact—hard as it may be to convince the farmer of it if his chicken-coop has been visited by weasels—that in the long run he receives more good than harm from them.

If their burrows are found it is not difficult to so set a trap at the entrance that they will be caught. Notwithstanding the common opinion to the contrary, weasels are neither very shy nor very cunning. I have repeatedly had them crop up within twenty feet and watch me from the sheltering undergrowth or a brush-heap.

OTTER.

Lutra canadensis (Schreber).

Mustela lutra canadensis Schreb., Säugth., 1776, Pl. CXXVI., B; text, 1778.

The common otter was originally found in favorable localities throughout the United States, and in British America nearly to the Arctic Ocean. It is still sparingly scattered over this wide range.

I have not been able to find any proof of the otter's having been taken in this county, but at least an occasional one must have wandered along the larger rivers. Otters are still found in the swamps in the southern part of the state. During the winter of 1907–08 several were taken in the cypress swamps of Alexander county.

INSECT-EATING ANIMALS.

INSECTIVORA.

COOPER'S SHREW; LONG-TAILED SHREW.

Sorex personatus I. Geoffroy-Saint-Hilaire.

(Mém. du Mus. Hist. Nat. Paris, XV., 1827, pp. 122–125.)

Sorex cooperi Bachm., Journ. Acad. Nat. Sci. Phil., 1837, p. 388, Pl. XXIV., Fig. 7.

This little mammal is distributed over all the northern part of North America from the Atlantic to the Pacific, and south, in the

mountains, to Tennessee and South Carolina. Kennicott reports it as far south in Illinois as Murphysboro, Jackson county. The only specimens in our collection are from Normal, in McLean county, and from a tamarack swamp in McHenry county.

This species is easily distinguished from our other shrews by its small size and long tail. The measurements for adult specimens are about as follows: Total length, 4 in. (100 mm.); tail, 1.5 in. (40 mm.); hind foot, .5 in. (12 mm.).

The color above is sepia, and the long hairs are tipped with clove-brown; below, it is ashy gray. The tail is dark above, whitish below.

We have taken the species only in swamps or low ground, but it has been taken in almost every possible habitat within its range. It has not been found in this county so far as I can ascertain, though it is probably present here in small numbers.

All that we know of its habits indicates that this species, like all the other shrews, is exceedingly energetic and voracious. Merriam says "In less than eight hours one of these tiny wild beasts had attacked, overcome, and ravenously consumed two of its own species, each as large and as heavy as itself." It does not hibernate, but is active all winter, even when the temperature is below zero.

The number in a litter, as reported, varies from two to ten. There are six mammæ, and probably they indicate about the average number of young. Embryos have been found in specimens from June to September at least. This would imply two or three litters a year.

So far as known this shrew is beneficial to man and worthy of protection. A closely related European species has been known to catch young trout, but the habit has never been reported for our species.

BACHMAN'S SHREW.

Sorex longirostris Bachman.

(Journ. Acad. Nat. Sci. Phil., III., Part II., 1837, pp. 370–373, Pl. XXIII., Fig. 2.)

A single specimen taken November 14, 1907, in a tamarack swamp near Pistakee Bay, McHenry county, Illinois, is referred to this species by C. Hart Merriam. The skull was badly smashed by the trap. When Merriam's paper on the shrews was published, in 1895, the only known specimens of this species were a half dozen from Raleigh, North Carolina. In regard to our specimen sent to

him Dr. Merriam writes as follows: "Unfortunately the skull is broken at the junction of the rostrum with the cranium proper, and as it has not been removed from the skin I am still in ignorance of the skull characters. The teeth, however, leave little doubt that the species is *Sorex longirostris*, of which we already have specimens from Indiana. Its occurrence in a tamarack swamp in extreme northern Illinois, however, is surprising."

The following are my own data on the specimen, taken from my note-book. Length, 76 mm. (3 in.). Tail, 31 mm. (1.2 in.). Hind foot, 11 mm. (.4 in.). Color (described after putting in alcohol but, I think, before any noticeable change had taken place): The back is sepia with clove-brown-tipped hairs mingled. These are more abundant toward the rump. The color is lighter below, varying through drab to drab-gray, and being still paler on the throat and chin. The tail is bicolor—clove-brown above, drab-gray below. The feet are drab-gray, but the palms and soles are darker.

I have ventured to call the species Bachman's shrew, rather than to translate the Latin specific name, *longirostris* (long-nosed), since in fact the muzzle of this species is broader and shorter than in our other species.

SHORT-TAILED SHREW.

Blarina brevicauda (Say).

Sorex brevicaudus Say, Long's Exped. Rocky Mts., I., 1823, p. 164.

The typical form of the short-tailed shrew is found from western Nebraska and Manitoba to the Atlantic. On the south it intergrades with the subspecies *carolinensis*, which is found to the Gulf. I have referred all my specimens from the northern half of Illinois to the typical form, though it is possible that some of them are, rather, transitional forms. A few specimens taken in the southernmost county of the state, I have regarded as the above subspecies.

The average size for *brevicauda* given by Merriam* is about 125 mm. (4.92 in.).

The following table shows the measurements of 44 specimens from the northern half of the state.

* N. Am. Fauna, No. 10, p. 10.

Accessions number	Sex	Length				County
		Total		Tail		
		in.	mm.	in.	mm.	
37805....	Female...	4.57	116	.79	20	Champaign
37811....	Female...	4.06	103	.94	24	Champaign
37816....	Female...	4.84	123	.98	25	Champaign
37860....	Male.....	3.86	98	.94	24	Champaign
37861....	Male.....	4.06	103	.83	21	Champaign
37892....	?.....	4.80	122	.87	22	Champaign
37993....	Female...	4.80	122	1.02	26	Champaign
37994....	Female...	5.08	129	1.06	27	Champaign
38233....	?.....	3.94	100	.91	23	Champaign
38234....	?.....	4.53	115	.98	25	Champaign
38262....	Male.....	4.13	105	.87	22	Champaign
38263....	Male.....	4.57	116	.98	25	Champaign
38264....	Female...	4.49	114	.79	20	Champaign
38277....	Female...	4.13	105	.94	24	Champaign
38278....	?.....	4.25	108	.79	20	McHenry
38304....	Female...	4.45	113	1.02	26	Champaign
38324....	Male.....	4.49	114	.71	18	Warren
38325....	Female...	4.61	117	.94	24	Warren
38326....	Female...	4.53	115	.75	19	Warren
38332....	Male.....	4.41	112	.98	25	Warren
38334....	Female...	4.37	111	1.02	26	Warren
38335....	Male.....	4.65	118	.71	18	Warren
38336....	Female...	3.97	101	1.02	26	Warren
38338....	Male.....	5.20	132	.91	23	Warren
38340....	Male.....	4.88	124	.75	19	Warren
38358....	Female...	4.25	108	.87	22	Champaign
38364....	Male.....	4.49	114	.83	21	Champaign
38372....	Male.....	4.92	125	.94	24	Champaign
38390....	Male.....	5.08	129	1.02	26	Champaign
38405....	Female...	4.68	119	.87	22	Champaign
38406....	Female...	4.65	118	.83	21	Champaign
38428....	Female...	4.68	119	.91	23	Champaign
38435....	Female...	4.45	113	.79	20	Champaign
38436....	Female...	4.49	114	.94	24	Champaign
38457....	Female...	4.53	115	1.10	28	Champaign
38463....	Female...	4.88	124	.79	20	McHenry
38464....	Female...	4.68	119	.79	20	McHenry
38469....	Female...	4.76	121	1.10	28	McHenry
38470....	Male.....	4.61	117	1.06	27	McHenry
38471....	Female...	4.13	105	.83	21	Champaign
38472....	Female...	4.13	105	.79	20	Champaign
38481....	Female...	4.57	116	.94	24	Champaign
39602....	Female...	4.25	108	.98	25	Iroquois
39629....	Female...	4.57	116	.94	24	Champaign
Average..	.....	4.53	115	.87	22	

Although shrews are among the most common of the small mammals on the farm they are often confused with mice or moles. They may be easily distinguished from all our mice by their long, pointed nose, by the absence of visible external ears, and by their short, glossy, velvet-like fur and short tail. They may be distinguished from moles by their much smaller size, and by their small front feet.

The color varies somewhat, but is usually sooty lead above and a lighter ashy lead below. There is sometimes a rusty flush to the color when seen in certain lights.

If there are any factors of environment that appeal especially to this shrew no observer has yet been able to determine what they are. All places seem alike acceptable to it, and any one who has trapped for small mammals long will be tempted to believe literally in the following statement of Rhoads: "Forest and plain, sand and clay, barren or fruitful field, backwoods and door-yard, heat and cold, wet and dry, day and night have common charm for this cosmopolite."* Our own specimens were taken in practically every form of habitat where any other small mammal was found—even in the center of large corn fields in summer, where the white-footed prairie-mouse was the only other resident. They are usually closely associated with field-mice or house-mice, being almost invariably taken in the same localities. Very rarely does it happen that any locality yields shrews alone.

Shrews inhabit burrows and runways very similar to those of the meadow-mice. To what extent these burrows actually are the work of the shrews themselves does not seem to be proven. That shrews do take possession of the burrows of meadow-mice seems certain, but it is generally supposed that they also make burrows of their own. Their nests are in burrows, and are made of leaves, grass, etc. Shull found one nest made entirely of the hair of meadow-mice.

The food of the shrews is extremely varied. They are known to feed largely on insects, larval and adult, worms, and snails. They also eat dead mammals, even of their own kind. In captivity at least, they attack mice much larger than themselves, and kill and eat them. Their ferocity is remarkable. I once put a small shrew into a tin bucket with a house-mouse of twice its own weight. The

* "The Mammals of Pennsylvania and New Jersey," p. 192.

shrew immediately attacked the mouse most furiously. The mouse simply fought in self-defense, but the shrew returned to the attack again and again. It would approach the mouse with its feet set far apart, its whole form showing a peculiar tense alertness and relish of the fray, noted by Kennicott. In less than ten minutes the shrew had chewed off one ear and bitten off the tail of the mouse, and, finally, by a lucky dash, had seized the mouse by the base of the skull, killed it instantly, and had eaten out the brains. They are supposed to eat but little vegetable food, but I have taken them in new traps baited with oatmeal alone, and their mouths were full of the oatmeal when caught. They have also been known to eat nuts.

There are four to six in a litter, and two or three broods a year. They may be born at any time of the year, though less frequently in winter.

Shrews are provided with large glands, in the vicinity of the shoulder, that give off an offensive odor, and presumably produce a taste displeasing to other animals. Cats and dogs seldom eat shrews, although they may kill them. To what extent these glands protect shrews against attack by wild mammals is hard to tell, but as shrews are often found dead and not eaten, it would seem likely that the larger wild carnivores kill them and leave them. Certainly these glands do not protect the shrews from hawks and owls, both of which feed on them extensively.

It is unfortunate, that the shrews should be so generally classed in the popular mind with mice. The only possible injury that shrews may do, is to destroy some insects that are beneficial to the farmer. This is merely a hypothetical injury, and is certainly more than compensated by the good they do. A. F. Shull,* who made an elaborate study of this species at Ann Arbor, Michigan, has estimated that a single shrew during one month might kill and use for food the equivalent of 20 meadow-mice, 30 house-mice, or 450 May-beetles. In captivity shrews killed and ate all mice confined with them, and there is no reason to believe that they are less blood-thirsty when free. Of course the proportion of mice, snails, and beetles or other insects in their food will vary according to circumstances, but in any case the insatiable ferocity of the shrews must work for man's benefit. Probably no other mammal, unless it be the skunk when on its good behavior, is so uniformly beneficial to the

* Am. Nat., Vol. XLI., pp. 495–522.

farmer. Shrews certainly merit better treatment than they usually receive at the farmers' hands. Fortunately they are shy animals, largely nocturnal in their habits, and so are seldom victims of man's stupidity.

CAROLINA SHREW.

Blarina brevicauda carolinensis (Bachman).

Sorex carolinensis Bachm., Journ. Acad. Nat. Sci. Phil., VII., Part II., 1837, pp. 366–370.

I have referred a few specimens taken in Alexander county, the most southern county in the state, to this subspecies. The distinction between it and typical *brevicauda* is thus summed up by Merriam: "*Blarina carolinensis* is merely a small edition of *B. brevicauda*, lacking the more accentuated features of the latter in the way of massiveness and angularity of the skull and lower jaw. It differs also in the lateral unicuspidate teeth. They are more nearly vertical, and the fifth is generally hidden when viewed from the outside."

The measurements of my specimens are as follows.

Accessions number	Sex	Length				County
		Total		Tail		
		in.	mm.	in.	mm.	
37916.....	Female...	3.54	90	.75	19	Alexander
37919.....	Female...	3.46	88	.87	22	Alexander
37920.....	Male.....	3.62	92	.75	19	Alexander
37926.....	Female...	3.70	94	.....	.....	Alexander
37927.....	Male.....	3.82	97	.98	25	Alexander
Average.....		3.62	92	.83	21	

The habits of this subspecies agree in all respects with those of the short-tailed shrew so far as known, and economically it takes the place of that form in the southern part of the country.

SMALLER SHREW.

Blarina parva (Say).

Sorex parvus Say, Long's Exped. Rocky Mts., I., 1823, p. 163.

The geographic range of this species is from Texas and eastern Nebraska eastward to the Atlantic.

Measurements are as follows: Length, 2.95–3.15 in. (75–80 mm.); tail, .63–.71 in. (16–18 mm.); hind foot, .43 in. (11 mm.).

The color of the upper parts is sepia to dark hair-brown; the under parts are ash-gray. The tail is bicolor.

From data at hand one may conclude that the habitat of this shrew is as varied as that of the larger species. My specimens were taken in my garden in Urbana, in the barren sand area of Mason county, and in the till plains of Champaign county.

The species seems seldom to be abundant, and its habits have been little studied. Presumably they are much like those of the larger species.

STAR-NOSED MOLE.

Condylura cristata (Linnæus).

Sorex cristatus Linn., Syst. Nat., I., 1758, p. 53.

The range of the star-nosed mole is from Hudson Bay to Manitoba on the north, and to Minnesota, northern Illinois, and, in the mountains, to South Carolina.

So far as known it is nowhere common in Illinois, but is occasionally found in the northern part of the state. Professor Frank Smith, of the Department of Zoology of the University of Illinois, found a dead specimen in the vicinity of Urbana, and other reliable observers have reported it in the county. I have never been able to take it in Illinois myself, and there are no specimens in our collections. It is easily distinguished from the common mole by the fringed disk on the end of the nose.

The color is a dull sooty slate, without the glossy sheen of the common species.

The species is a northern one, and in the southern part of its range is found chiefly in cold damp localities. Excepting this preference for a moist habitat we know little difference between the habits of this species and those of the common mole.

It is too rare to be of importance economically in this state.

COMMON MOLE; SHREW-MOLE.

Scalopus aquaticus machrinus (Rafinesque).

Talpa machrina Raf., Atlantic Journ., I., 1832, p. 61.

The common mole, under various subspecific forms, is found over most of the eastern half of the United States. The range of the form called *machrinus* is given as Wisconsin and Minnesota to Tennessee and Missouri; and west to eastern Kansas, Nebraska, and southwestern South Dakota.

Teeth: incisors, $^{3}/_{2}$; canine, $^{1}/_{0}$; premolars, $^{3}/_{3}$; molars, $^{3}/_{3}$. The second and third incisors of the upper jaw are small and often missing. The molars and premolars have very irregular surfaces, the projections of the lower jaw fitting into corresponding hollows in the upper one, and *vice versa*. This construction of the teeth and the strictly up and down motion of the jaws are well adapted to the chopping up of insects or other animal food.

The average size of twenty-seven adult specimens from Champaign county is as follows: Total length, 7.13 in. (181 mm.); length of tail, 1.34 in. (34 mm.). Specimens from the western part of the state are somewhat larger. The fore limbs to the wrist, are concealed under the skin. The fore paws are enormously developed. The toes, five in number, are webbed their whole length. The length of the palm is .6 to .8 of an inch (15–20 mm.), but the width is greater, being from .8 of an inch to an inch (20–25 mm.). This great width is due to a flap of skin on the lower edge, the rigidity of which is maintained by an extra sickle-shaped bone. The palm is margined with stiff hairs. The nails are stout, flattened, semi-cylindrical, and translucent enough to shew the bifid tips of the last finger-bones within. The tail is squarish, especially at the base.

The nose is slender and pointed. The snout is prolonged beyond the lower jaw about .3 of an inch (8 mm.). It is flattened and deeply grooved below, and is truncate at the apex. The truncated surface looks upwards and contains the nostrils. At the tip is a hard, nail-like body. The thick fur hides the eye and the ear, but if the hair be cut off close both may be found. The eye appears as a protuberance, about the size of a pinhead, .8 to 1 inch (20–25 mm.) from the end of the snout. There is no true pinna, or external ear, but the external auditory opening is prolonged a short distance beyond the head by a cartilaginous tube.

The mammæ are six in number. The posterior pair are in the usual pelvic position, but the middle pair are so situated that the teats are near the knees. The front pair also are in an unusual position, being toward the back, and on the side, back of the fore leg. It is evident that if the mammæ were in the usual place beneath the body they could not be reached by the young, owing to the short legs of the dam and the projecting snout of the young moles.

The fur, except on the snout and extremities, is dense, fine, and silky, with but very little slope, so that it offers little resistance to rubbing in any direction. The general color is hair-brown, sometimes grayish, sometimes warmed to bister or sepia, but is always obscured by a shifting, sheeny luster. The base of the hairs is plumbeous. The chin, throat, upper surface of fore paws, and the wrists are much lighter in color, and often suffused with shades varying from ochraceous to ferruginous or, in spots, even to orange. The tail is whitish at base, nearly naked, and pinkish at the tip, as are also the tip of the snout and the toes.

The moles are almost unique among vertebrates in leading a truly subterranean life in burrows of their own construction, not only finding a refuge in them, like so many other animals, but also seeking their food by plowing their way through the ground as a fish seeks its food in the water. Their burrows are made, for the most part, by simply pushing the earth aside, and not by loosening the dirt and bringing it to the surface as is the habit with most burrowing animals. This necessitates enormous strength in the fore limbs and shoulders. Moreover there is need that these limbs be able to work in as small a space as possible. If we estimate the average diameter of a mole-run as two and a half inches, a simple computation will show that if the working distance of each fore limb were increased a quarter of an inch it would add at least 40 per cent. to the energy required for excavating every unit length of burrow. This ability to economize in working room is secured by the shortness of the fore limbs and still more by their position. Instead of being attached, as usual, on the side of the thorax, the whole pectoral girdle is brought forward around the neck. This is accomplished in the following manner: the sternum is produced forward in a separate keel-shaped bone, and the ventral attachment of the clavicle is to the front end of this.

Moles are found in all parts of the county excepting the flood-plains, but they are not in general very abundant on the bluffs or in cleared pastures excepting where these border on cultivated lands. They are fairly abundant in groves, but most so on the till plains and the moraines where the sod has been left unturned for a few years. They seem to prefer the neighborhood of cultivated lands, although they seldom venture far out into large fields under regular crop rotation.

The depth of their burrows below the surface of the ground varies considerably. In spring, autumn, and in damp seasons or in damp places in summer the burrows are at a depth of one to three inches. During summer and early autumn, when the ground is drier, they are at a depth of from four to eight inches. Others are still deeper—from eighteen inches to two feet—though these burrows are somewhat restricted in extent and are apparently found only in the vicinity of their nests.

The nests of moles are under logs or stumps or situated from six to eighteen inches—or perhaps deeper—below the surface. Those I have examined were made of nearly whole leaves and dried grass, and were all near a stump, tree, or fence. In all cases observed there were two or more exits, one of which led downwards to a deeper runway. In case a considerable area is occupied by moles, it will be found that runways of different moles are evidently connected, all burrows in the locality forming one extensive system, and it seems certain that many runs are used by several moles in common. However, in captivity moles are quarrelsome, and one can hardly imagine anything truly gregarious in their life. The persistence of the mole in keeping open a burrow once adopted as a main runway is remarkable. One often finds such runways crossing cow-paths or roadways, where they must be crushed in nearly every day, yet they are repaired, for months, as often as injured.

Apparently but few observations have been recorded on the breeding habits of moles. Our own observations indicate that there is but one litter a year, produced in April or May, and that from three to six constitute a litter.

The question as to how far moles may be beneficial or injurious to the farmer has been investigated by the State Laboratory of Natural History, and the results will be published in a later issue of this Bulletin. Only a short résumé of the results are called for here.

The annoyance and injury caused by the burrowing of moles in lawns, cemeteries, etc., is well known; but besides this mechanical and as it were accidental injury, gardeners and farmers have maintained that moles did other injury by eating newly planted seeds and the subterranean parts of garden vegetables. Extensive investigation in this state and elsewhere has shown conclusively that while by far the largest part of the food of the mole consists of worms, grubs, and insects, they do also eat a small amount of vegetable food. They burrow along the rows of newly planted corn and sometimes certainly eat it. They sometimes eat potatoes also, and possibly other root crops. On the other hand they undoubtedly do considerable good by destroying harmful insects in the larval or mature stage. Whether they do more harm than good depends on circumstances. There are occasions, however, when they become pests and should be destroyed.

They have few natural enemies. Birds of prey seldom take them, and the *Carnivora* that kill them are no longer common. They may be driven out of small areas by odors which are offensive to them. They are very sensitive to those of naphthalin, moth-balls, carbon bisulphid, formalin, and the like, or even kerosene. These substances put in and around their runs will drive them from the immediate locality. Our own attempts to poison them have been of uncertain success, as it has been difficult to determine, even approximately, the number killed. In captivity they eat bits of raw beef readily, and it seems probable that they might be poisoned by putting strychnine or arsenic on bits of meat and scattering them in the runs. Some claim to have had good success with poisoned sweet corn.

Trapping seems to be the most practical way of exterminating them. Of the various types of mole trap on the market, all have been found equally efficient, the only difference being a matter of price, convenience in manipulating, conspicuousness, and the like. It should be remembered that mole-runs are of two kinds: the temporary or exploring runways, which are driven in search of food, and which may never be entered again; and the main or permanent runways traversed every day. These latter are the ones on which the traps should be set. Whether a run is in use or not may be determined by crushing in the roof with the heel and watching for repairs. If in use it will be repaired, and usually within twenty-four hours.

BATS.

CHIROPTERA.

SAY'S BAT.

Myotis subulatus (Say).

?*Vespertilio subulatus* Say, Long's Exped. Rocky Mts., II., 1823, p. 65.

This species has a general distribution throughout North America east of the Rocky Mountains.

Dental formula: *i*, $^2/_3$; *c*, $^1/_1$; *pm*, $^3/_3$; *m*, $^3/_3$.

The length of Say's bat is about like that of the little brown bat, 3.15–3.55 in. (80–90 mm.), but the fore arm is usually a trifle shorter—about 1.4 in. (34–37 mm.). The ears (Fig. 5) are long, reaching beyond the nose when laid forward. The tragus is very slender, and gave the bat its specific name, *subulatus* meaning awl-shaped.

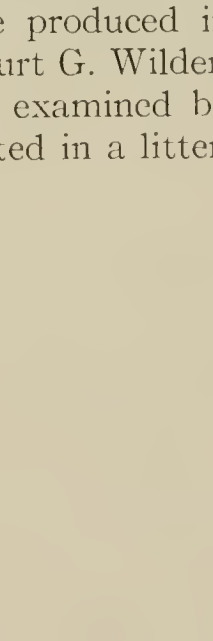

Fig. 5. Ear of Say's bat. (Miller.)

The color resembles that of the little brown bat, both species varying considerably in depth of color.

I have never taken this bat within the state, but in many localities it can not be uncommon. There is one specimen without data in our collections, and one from East Cairo, Ky. It is apparently very unevenly distributed. By some reliable observers it is reported as being uncommon, while others in similar environment report it as very abundant. It hibernates, and has been found in winter in hollow trees in immense numbers. The young are produced in June. Twenty pregnant females examined by Dr. Burt G. Wilder, each contained two young, as did also each of ten examined by Dr. A. K. Fisher*. More than this have been reported in a litter, but two is the usual number.

*Merriam's "Mammals of the Adirondack Region," p. 195.

LITTLE BROWN BAT.

Myotis lucifugus (Le Conte).

Vespertilio lucifugus Le Conte, McMurtrie's Ed. Cuvier's Animal Kingdom, I., App., 1831, p. 431.

The little brown bat is found throughout the whole of North America north of the southern boundary of the United States and between the Atlantic Ocean and the Rocky Mountains.

Dental formula: *i*, $^2/_3$; *c*, $^1/_1$; *pm*, $^3/_3$; *m*, $^3/_3$.

The length is 3.15–3.55 in. (80–90 mm.); fore arm, 1.50–1.54 in. (36–40 mm.). The wing-membranes are entirely naked except a narrow line close to the body. The ears are short for a bat, reaching barely to the tip of the nose when laid forward.

Fig. 6. Ear of little brown bat. (Miller.)

The hairs are everywhere blackish slate at base. The general color is dull brown, varying from wood-brown to sepia, with a distinct gloss in certain lights. The under parts are lighter.

The little brown bat and Say's bat closely resemble each other, but may be distinguished by the ears. The ears of the former (Fig. 6) when bent forward do not reach the tip of the nose, while those of Say's bat (Fig. 5) reach beyond the tip, and its tragus is more slender than that of the little brown bat, and is also different in shape.

Several bats of this species are preserved in a jar in the Laboratory collections, evidently having been found together somewhere in the state, but collection data are wanting. The species has been reported from Cook county and from Cairo, in Alexander county, and is undoubtedly not uncommon throughout the state.

SILVER-HAIRED BAT.

Lasionycteris noctivagans (Le Conte).

Vespertilio noctivagans Le Conte, McMurtrie's Ed. Cuvier's Animal Kingdom, I., 1831, p. 31.

This species ranges throughout the United States and north to the Peace River at least.

Dental formula: *i*, $^2/_3$; *c*, $^1/_1$; *pm*, $^2/_3$; *m*, $^3/_3$.

Ears (Fig. 7) short, nearly as broad as long, when laid forward reaching barely to nostril, basal lobe very large. Tragus short,

straight, and bluntly rounded at tip, width much greater than length of anterior margin. The back of the interfemoral membrane is furred on the basal half.

The general color over all the body is a dark chocolate or seal-brown with white-tipped hairs. In general the individual hairs for the basal two-thirds are a dark seal-brown shading to a narrow band of richer color and abruptly tipped with white. The difference in general effect in the different parts of the body is due to the relative length of the white tips. On the head the white tips are short, while over the back they are long, giving a grizzled appearance to that part. The ears are dark clove-brown.

Fig. 7. Head and ear of silver-haired bat. (Miller.)

This species is one of the most common in this locality. It has often been taken on the campus and in the buildings of the University. It has been reported from various parts of the state, and is probably common throughout Illinois. Merriam says that the silver-haired bat in the Adirondacks hunts chiefly over the watercourses, but in this state it seems to be quite as common in towns and villages.

The young are produced in July. There are usually two in a litter.

In the northern part of its range it is said to migrate south in winter, but it is also found hibernating in hollow trees in New York State.

GEORGIAN BAT.

Pipistrellus subflavus (F. Cuvier).

Vespertilio subflavus F. Cuvier, Nouv. Ann. Mus. d'Hist. Nat. Paris, 1832, p. 17.
Vesperugo carolinensis H. Allen, Monogr. Bats of N. A., 1893, p. 121. (Not *Vespertilio carolinensis* Geoff.)

The general range of this species is from the Atlantic coast west to Iowa, and south to eastern and southern Texas..

Dental formula: *i*, $^2/_3$; *c*, $^1/_1$; *pm*, $^2/_2$; *m*, $^3/_3$.

The length of the fore arm of this species is about 1.3 in. (34 mm.). The ear (Fig. 8) is rather long, extending just beyond the nostril when laid forward. The tragus is about half the length of the ear, with bluntly rounded tip.

The color is a light yellowish brown below. On the upper parts this color is clouded with a darker brown. The individual hairs on the back are plumbeous at base, yellowish brown to near the tip, which is dark brown. There are also longer hairs which are clear yellowish brown to the tip.

Fig. 8. Head and ear of Georgian bat. (Allen.)

The sixty-nine bats of this species in the Laboratory collections are undoubtedly Illinois specimens, but are without locality data. Kennicott found this bat at Cairo, in the extreme southern part of this state, and it was reported from Wisconsin by Strong, but not by later observers so far as I know. If it occurs in the northern part of Illinois it must usually be rare. Either the species is often overlooked or its distribution is very uneven over the most of its range. It is one of the species found in caves.

BROWN BAT.

*Eptesicus melanops** Rafinesque.

(Annals of Nature, 1820, p. 2.)

Vespertilio fuscus Beauv., Cat. Peale's Mus. Phil., 1796, p. 14.
Adelonycteris fuscus H. Allen, Monogr. Bats of N. A., 1893, p. 112.

This species is generally distributed over the United States and the adjoining parts of the British provinces.

Dental formula: i, $^2/_3$; c, $^1/_1$; pm, $^1/_2$; m, $^3/_3$.

This is one of our larger bats, the total length being about 4.4 in. (110–112 mm.), and the length of the fore arm about 1.7 in. (43–46 mm.). The ears (Fig. 9) barely reach the nostril when laid forward. The basal third is furred on the outside, and there is a

* See Miller's (Gerrit S., Jr.) "The Families and Genera of Bats," Bull. 57, U. S. Nat. Mus., pp. 207–210.

sprinkling of hairs towards the front margin on the inside. The front margin is thickened.

The color varies from near cinnamon to clear bister or sepia, always being paler below. In our specimens it is bister above and hair-brown below. The base of the fur is dusky throughout.

This species has been reported from various parts of the state, and from the adjoining states. Two specimens have been taken at different times in the chemistry building of the University. H. Allen believes this species to be, on the whole, the most common bat in the United States. However that may be, the red bat has been taken far more often in this vicinity.

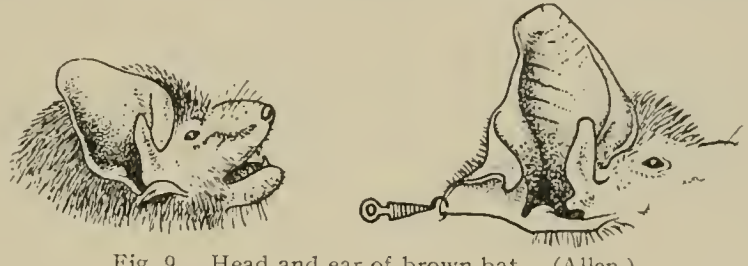

Fig. 9. Head and ear of brown bat. (Allen.)

It is not usually found hanging by its thumbs or feet, but rests with its folded wings flat upon some rough supporting surface, its head being down, In this latitude it is one of the species frequenting caverns and hibernating in them.

RED BAT.

Lasiurus borealis (Müller).

Vespertilio borealis Müll., Natursyst., Suppl., 1776, p. 21.
Atalapha noveboracensis of Kennicott and various authors.

This species in its various forms is found throughout North America to the arctic regions. The typical form is found in eastern North America from Canada to Florida and Texas and west to Colorado. It is by far the most common bat in this vicinity, or at least the one most commonly taken.

The two species of *Lasiurus*, namely the red bat and the hoary bat, may be distinguished from all the other bats of the state by the fact that the portion of the flying membrane between the hind legs is entirely covered with thick fur on the outside. The red bat is the smaller of the two species. The fore arm is 1.35–1.6 in. (38–43 mm.) in length. The ears (Fig. 10) are very short and rounded for a bat, and the basal lobe has a notch in front which is lacking in the hoary

bat. The border of the ear is light brown, and there is no clump of hair on the back of the fore arm.

On the back, neck, and head, the base of the hairs is reddish black abruptly changing to pinkish buff, and this in turn shading to bright chestnut. The tips of the longer hairs are white. The hairs on the posterior three-fourths of the interfemoral membrane lack the black at the base, otherwise they resemble those on the back. Toward the face the darker tips of the shorter hairs disappear, the general color being a light buff. There is a tuft of white hairs at the base of the thumb and along the base of the fourth finger. At the side of the neck the white tips of the hairs are so long that they form a white patch. The white tips are also rather more conspicuous over the throat than over the most of the body. The breast, the belly, and adjacent parts of the wing-membrane are a pale fawn-color.

Fig. 10. Head and ear of red bat. (Allen.)

According to Merriam* this species flies earlier in the evening than other bats do, and has even been seen flying in a cloudy afternoon. It is often taken here in the early evening within the city limits, especially in the early summer when encumbered with its young. It is frequently found attached to twigs of trees and shrubs, and in that position very closely resembles a dead leaf—an interesting example of protective mimicry.

The red bat and the hoary bat differ from all other bats in this vicinity in having four mammæ instead of two. The young are produced in May or June, and are two to four in number. They are nursed for some time, and are found clinging to the mother when they are at least half grown. I have never found more than two that were over one-fourth grown attached at the same time, however, though a female with a single half-grown one attached is very common. It is difficult to imagine how the mother could carry her whole family at once when they reach that size. The mothers show considerable attachment for their young, and if separated from them and frightened away are almost sure to return to look for them. I have kept the young of the red bat in captivity for some weeks

* "The Mammals of the Adirondack Region," p. 181.

feeding them on milk, which they learn to lap up. They become quite tame, and show as much intelligence and affection as most wild pets do.

HOARY BAT.

Lasiurus cinereus (Beauvois).

Vespertilio linereus Beauv., Cat. Peale's Mus. Phil., 1796, p. 15. (Obvious misprint for *cinereus*.)

Atalapha cinerea of Kennicott and various authors.

This species, though apparently seldom abundant in the United States, ranges throughout North America from the Atlantic to the Pacific, north to Athabasca at least, and south through Mexico and Central and South America to Chili. It breeds in Canada and the northern United States, but migrates south in winter.

The general shape of this bat is like that of the red bat, but it may be distinguished from that species by characters already designated; namely, by its larger size (fore arm over 2 in., or 50 mm., in adults), by the blackish borders of the ears (Fig. 11) and the absence of a notch in their lower lobes, and by the distinct patch of fur near the base of the fore arm.

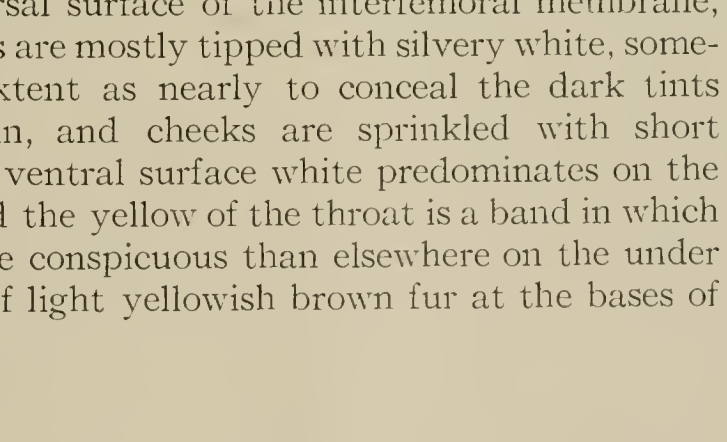

Fig. 11. Head and ear of hoary bat. (Allen.)

The color varies considerably, but the following description applies to the few Illinois specimens that I have seen: The general color is a mixture of light yellowish brown, deep umber-brown, and white, the yellowish brown being clear and unmixed on throat, head, and under side of membranes, the umber-brown predominating on the back and on the dorsal surface of the interfemoral membrane, where, however, the hairs are mostly tipped with silvery white, sometimes to so great an extent as nearly to conceal the dark tints beneath. The lips, chin, and cheeks are sprinkled with short blackish hairs. On the ventral surface white predominates on the belly, between which and the yellow of the throat is a band in which the umber-brown is more conspicuous than elsewhere on the under parts. There are tufts of light yellowish brown fur at the bases of

the thumb, fifth finger, and fore arm, like the fur on the under side of the wing-membranes. On the middle of the back the individual hairs are colored as follows: deep plumbeous at base, light yellowish brown (shading to umber towards apex) through middle half, umber-brown near apex, silvery white at tip.

But little has been recorded of the habits of this bat. It is a strikingly large and handsome species, but seems to be nowhere abundant. There are probably two to four young, for females with all four mammæ used have been taken. In the northern part of its range it migrates south in winter.

RAFINESQUE'S BAT.

Nycticeius humeralis (Rafinesque).

Vespertilio humeralis Raf., American Monthly Magazine, III., 1818, p. 445.

This bat is found from eastern United States west to Arkansas and western Texas.

Dental formula: *i*, $^1/_3$; *c*, $^1/_1$; *pm*, $^1/_2$; *m*, $^3/_3$.

Fig. 12. Ear of Rafinesque's bat. (Miller.)

The length of the fore arm is 1.3–1.65 in. (34–38 mm.). The ears (Fig. 12) are thick and leathery. The tragus is short, blunt, and broad, and is bent slightly forward.

The fur is everywhere plumbeous at extreme base. The remainder of the hair varies from burnt umber to mummy-brown over the back, and from raw umber to hair-brown below. There are occasionally other variations in color.

This species is not rare in this county. It seems to be somewhat less likely to be found around towns than some other species of bats.

THE ECOLOGICAL SUCCESSION OF MAMMALS IN CHAMPAIGN COUNTY.

In the two accompanying charts (Pl. XXVII. and XXVIII.) an attempt has been made to represent graphically the variation in the abundance of the principal species of mammals in this region since the advent of white men. The second one is purely chronological, and applies only to Champaign county. The first one, however, represents the variations in the abundance of our mammals as related to the degree in which advancing civilization has modified primitive conditions, and is therefore more general in character, and should in a good degree be true for other sections in the prairie region of the Mississippi Valley.

A brief explanation of the nomenclature used in this chart to designate the progressive stages of civilization follows, the order observed corresponding to their consecutive occurrence.

(1) *The period of the explorer and hunter.* During this period the physiographic condition of the country remained unchanged, but the numbers of certain large animals were greatly diminished.

(2) *The period of the squatter and the range.* In this period settlements were begun, usually in timber near streams. Only a very small portion of the country was enclosed by fences or under cultivation, the settlers feeding their horses, cattle, and hogs largely on the natural products of the prairie and the forest. They were obliged to wage war on the larger carnivores in self-defense, and they hunted the most valuable fur-bearing animals for gain.

(3) *The period of settlement.* This is the time during which the land was practically all taken up by settlers or land speculators. Pasturage on public domain ceased, and considerable portions of the land were enclosed. Timber for the construction of buildings and fences was entirely from the local supply, and considerable areas of woodland were cleared for cultivation. In consequence of these inroads into the forests and the settling of the prairie the larger animals still remaining, such as deer, wolves, and wildcats, were greatly thinned out, but the extensive wooded-belts along the rivers still sheltered a few of them.

(4) *The improvement period.* This term serves to indicate the stage in which original prairie was drained and plowed, and woodland cleared and plowed—or at least so thinned out and pastured as to be profoundly modified in character. The cultivated ground is supposed to be either pasturage or land under rotation of crops. This is the present stage of by far the greatest part of the county.

(5) *The market-garden stage.* This term represents continuous and intense cultivation of limited areas of the land.

(6) *The village stage.* This expression has reference to the stage of advancement in which houses are built separate from each other and considerable areas devoted to yards and gardens.

(7) *The city stage.* This period is reached when the buildings touch each other, and there is practically no open ground for mammalian life.

Of course these various stages grade into each other, and in only a limited portion of the county here and there would there be simultaneous attainment to any of the later stages. Moreover, it is evident that the early stages must hold over an area considerably larger than a single county in order to be characterized by distinctive mammalian life, while the later stages may prevail over progressively smaller and smaller areas and still be so characterized.

In the charts the lines represent the presence of the different animals, the varying size of each line indicating the relative abundance of that single species at different times, or during different stages of civilization. There is in the charts no comparison of one animal with another. A species is regarded as present so long as it seems certain that it bred within the county. Stragglers of deer and other large animals were seen much later than is indicated.

The data used in making the charts were gotten in various ways. The reminiscences of early settlers as to variation in the abundance of the larger animals have been utilized, and though differing in detail they agree very well, on the whole, in regard to the most important general facts. The early records of travel through the state also furnished some data; and, lastly, the study of present distribution has thrown much light on the conditions favorable to each particular species. While the charts are not to be taken as exact mathematical representations of the variation in abundance of our mammals, either chronologically or with reference to the stages of civilization, it is believed that they may give a tolerably accurate idea of the

change that has taken place in the mammalian population since the coming of the white man.

I can find no definite record of buffalo within the county. The early settlers often found buffalo skulls and buffalo-wallows, and buffalo-trails were common,—all showing the earlier abundance of the animals. Hornaday estimates that they left this part of Illinois about 1810.* A number of the very earliest settlers think that buffalo were seen here considerably later than that, but are unable to give positive facts. At any rate the main herd left about 1810. The elk also must have left about the same time. It should be remembered that this part of the state was surrounded by settlements on all sides before it was itself settled, and so the larger game was frightened off earlier than usual in the development of the country.

Beaver were seen, according to Mr. Parsons, of Homer, so late as 1860 in the vicinity of Broadlands. There were but few left, however, in 1835. The bear and the panther must certainly both have been occasional visitants, but I am unable to fix the date of their last appearance. They had disappeared by 1840, and the other large *Carnivora* had been thinned out. In consequence the deer were beginning to increase, and all accounts agree that there was a period of greatest abundance of deer about 1850. In a similar manner the destruction of the wolves and wildcats was followed by an increase in the abundance of foxes, raccoons, opossums, and skunks, till these, in turn, were killed off by man.

Following the diminution of the wolves and foxes there is also a period of greatest abundance of rabbits, and I believe that at present, each fall before the shooting season opens these animals are as abundant as they were under the conditions prevailing before the settlers came. The period of great abundance of squirrels, as indicated on the chart, was determined by various records. How far this abundance may have been due to the destruction of the large carnivores, and how far due to other agencies, I am unable to tell. All the rodents are subject to periodical fluctuations in abundance due to a combination of circumstances not fully understood.

In the case of weasels and shrews no variation in abundance is indicated in the chronological table. While there can be no doubt

* Rep. U. S. Nat. Mus. for year ending June 30, 1887, Map (following p. 548).

that certain stages of improvement are especially favorable for these species, these conditions exist in only a part of the county at a time, and are balanced by unfavorable ones elsewhere.

In general there has been a uniform diminution of fur-bearing animals from the first. The exception we note, is that of the muskrat. Of late years, owing to the low value of their skins and to the general prosperity and consequent increased means of earning money, the muskrats have not been so extensively trapped as formerly, and I believe that they are at least holding their own in the county. At present the improved drainage and increased use of underground drains are the most unfavorable conditions for the species.

In the case of bats, so far as available data go, the favorable and unfavorable changes—for example, destruction of birds of prey, on the one hand, and removal of forests, on the other—about balance; and while there must have been some fluctuations in the number of the bats in the county from year to year, and probably permanent variations in the relative abundance of the species, on the whole the number present now does not differ greatly from what it was a century ago, nor do we know of any great waves of increase or decrease since the first settlement of the country.

In the case of the smaller rodents—gophers, rats, and mice—there has probably been a continued increase from the first permanent coming of white men. The reason is evident. Man has furnished abundant food for these animals and has destroyed their worst enemies.

Buffalo and elk were wholly exterminated by hunters, and the beaver nearly so, before the first settlement in the county. The squatters and early settlers destroyed the larger *Carnivora* in self-defense, and this was followed during the early settlement and improvement stages by an increase of deer, opossum, and such smaller carnivores as raccoons, foxes, skunks, and weasels. As these smaller *Carnivora* are themselves diminished by man's persecution, the rabbits and smaller rodents increase, and this increase continues till a high degree of cultivation is attained. In the final stages of village and city all the *Mammalia* disappear except the bats—which remain in little-changed numbers—and the rats and mice, which are continually increasing.

NOTE.

Preparation of Poisoned Bait for Small Mammals.

The following method of preparing a poisoned bait for prairie-dogs, gophers, rats, and mice is recommended by the U. S. Department of Agriculture:

Dissolve one ounce of strychnia sulphate in a pint of boiling water, add a pint of thick sugar-sirup and stir thoroughly. The above quantity is enough to poison half a bushel of grain or corn, but smaller proportional quantities of grain and sirup may be mixed as desired. Wheat, corn, oatmeal, or corn-meal may be used. If, after thorough mixing, the solution is not sufficient to wet all the grain used, add a little water. Let the poisoned grain stand over night. If the grain is too wet, add a little corn-meal to take up the moisture. The oatmeal bait may be used immediately after mixing.

It should never be forgotten that whatever will poison vermin will poison other animals also, and too great care can not be used in handling any poisoned bait. The following poison is less dangerous to larger animals than the above, and is especially recommended for rats and mice.

Take one part of barium carbonate and four parts of flour or meal, add a little sweetening, and mix into a dough. Cut into pieces the size of a pea for mice, and about four times that size for rats.

For destroying carnivorous animals, meat poisoned with arsenic is the usual bait. We believe, however, that there is very little necessity for the use of such means of destruction in this state. Hunting or trapping will be quite as effective, and we believe quite as cheap in the end.

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Plate XXVI.

Fig. 1. View in the till plain. Moraine ridge in background. Habitat of white-footed prairie-mouse.

Fig. 2. A permanent pasture. Habitat of white-footed wood-mouse. Striped gophers and moles are common.

Cultural Chart of Variations in Abundance of Mammals of Champaign Co., Ill.

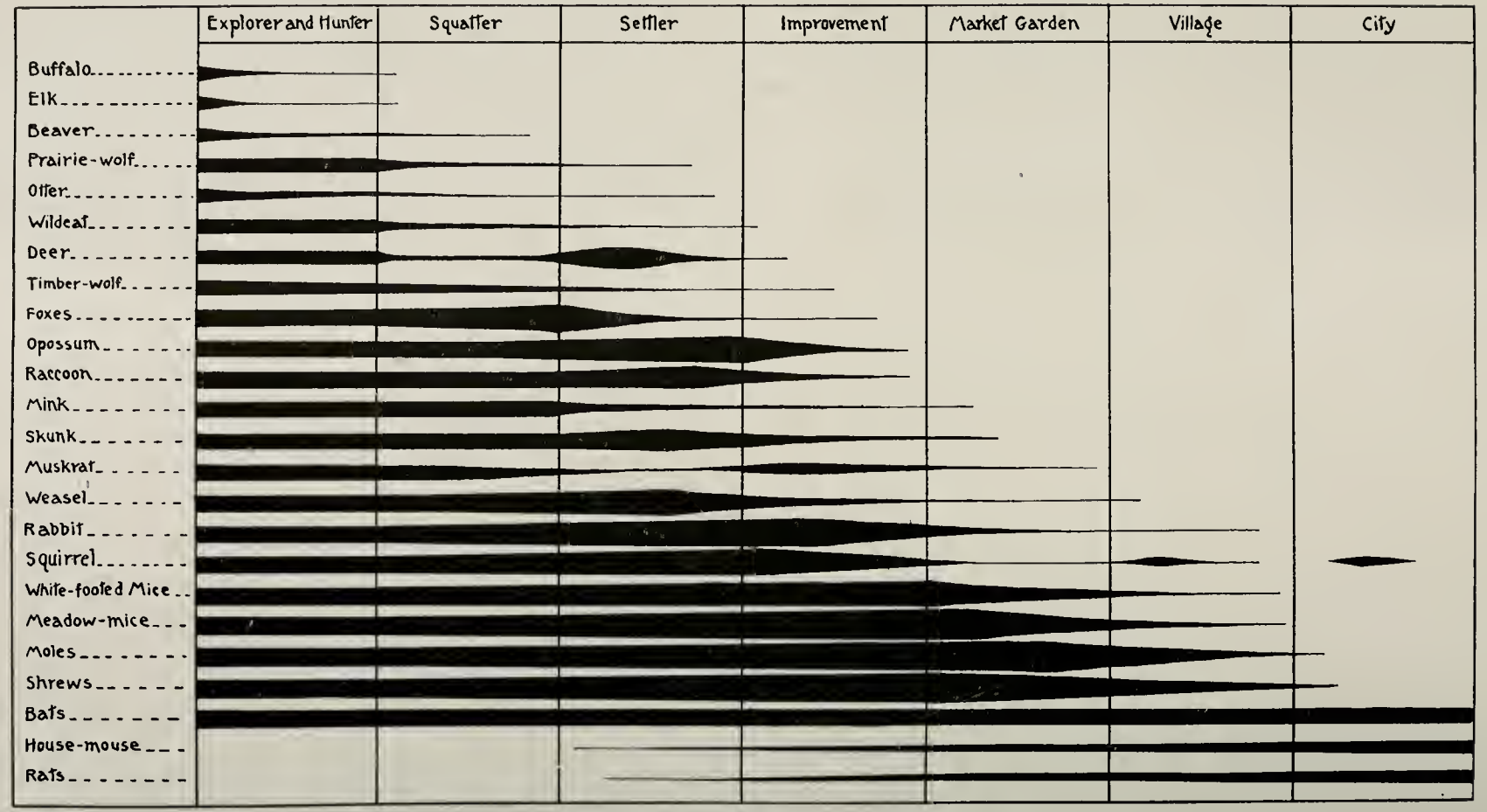

Plate XXVII.

PLATE XXVIII.

HISTORICAL CHART OF VARIATIONS IN ABUNDANCE OF MAMMALS OF CHAMPAIGN CO., ILL.